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SAFETY PRECAUTIONS

The following safety precautions should be observed prior to operation of the MM 4000 Multi-Axis Controller System.

This instrument is intended for use by qualified personnel who recognize shock hazards and are familiar with safety precautions required to avoid possible injury. Read this manual carefully before operating the instrument and heed all written warnings and cautions.

For your own safety and that of your equipment, always take the following precautions.

Disconnect the power plug under the following circumstances:

- *If the power cord or any attached cables are frayed or damaged in any way;*
- *If the power plug is damaged in any way;*
- *If the unit is exposed to rain, excessive moisture, or liquids are spilled on the unit;*
- *If the unit has been dropped or the case is damaged;*
- *If you suspect service or repair is required;*
- *Whenever you clean the case.*

To protect the unit from damage, be sure to:

- *Keep all air vents free of dirt and dust;*
- *Keep all liquids away from the unit;*
- *Do not expose the unit to excessive moisture (>85% humidity);*
- *Read this manual before using the unit for the first time.*

⚠ CAUTION

ALL ATTACHMENT PLUG RECEPTACLES IN THE VICINITY OF THIS UNIT ARE TO BE OF THE GROUNDING TYPE AND PROPERLY POLARIZED.

CONTACT YOUR ELECTRICIAN TO CHECK YOUR RECEPTACLES.

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⚠ CAUTION

THIS PRODUCT IS EQUIPPED WITH A 3-WIRE GROUNDING TYPE PLUG.
ANY INTERRUPTION OF THE GROUNDING CONNECTION
CAN CREATE AN ELECTRIC SHOCK HAZARD.
IF YOU ARE UNABLE TO INSERT THE PLUG INTO YOUR WALL PLUG RECEPTACLE,
CONTACT YOUR ELECTRICIAN TO PERFORM THE NECESSARY ALTERATIONS
TO ASSURE THAT THE GREEN (GREEN-YELLOW) WIRE
IS ATTACHED TO EARTH GROUND.

⚠ CAUTION

THIS PRODUCT OPERATES WITH VOLTAGES THAT CAN BE LETHAL.
PUSHING OBJECTS OF ANY KIND INTO CABINET SLOTS OR HOLES,
OR SPILLING ANY LIQUID ON THE PRODUCT,
MAY TOUCH HAZARDOUS VOLTAGE POINTS OR SHORT OUT PARTS.

⚠ CAUTION

OPENING OR REMOVING COVERS WILL EXPOSE YOU TO HAZARDOUS VOLTAGES.
REFER ALL SERVICING INTERNAL TO THIS INSTRUMENT ENCLOSURE
TO QUALIFIED SERVICE PERSONNEL WHO SHOULD OBSERVE
THE FOLLOWING PRECAUTIONS BEFORE PROCEEDING:

- TURN POWER OFF AND UNPLUG THE UNIT FROM ITS POWER SOURCE;
- DISCONNECT ALL CABLES;
- REMOVE ANY JEWELRY FROM HANDS AND WRIST;
- USE ONLY INSULATED HAND TOOLS;
- MAINTAIN GROUNDING BY WEARING A WRIST STRAP ATTACHED TO INSTRUMENT CHASSIS.

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INTRODUCTION

OVERVIEW

The MM 4000 Controller system is an indexer capable of driving multi-axial mechanical applications having up to four stepper- or DC-motorized axes. The system ensures precise axial motion control in which the user can define the units of measure. Movements can be either linear interpolated or non-synchronized. The axes can be driven in closed loop, provided the mechanisms have incremental encoders. These closed loops are numerical feed-forward PID (proportional, integral, derivative) type that have a sampling period of approximately 1 ms.

The MM 4000 Controller can function as a stand-alone unit (local mode), executing elementary movements in real-time from its front panel display with interactive menus, or it can execute programs written directly to the MM 4000 display and stored in its memory.

The MM 4000 Controller can also operate in remote command mode with a host computer, receiving operational commands and information downloaded via a link. This communication link can be either an IEEE-488 or RS-232. Exchanges with the host computer are done using ASCII strings, as described in section "Communications - Basic Functions" of the "TV Family of Controllers, Technical Reference" manual when the MM 4000 is configured for MM 5000 mode, or in standard Newport/Klinger codes when it is configured for Standard mode.

Thanks to the size of its RAM and battery-powered backup memory, the MM 4000 can permanently store and execute up to 64 user programs. The MM 4000 can also permanently store in its backup memory the parameters for each axis, such as the units, speed, acceleration, open-loop control, displacement limits, etc. This eliminates the need to setup and reload parameters at every startup.

Through the MM 4000's configuration the user can define the measurement units and make all resolution and compensation parameters transparent. This includes correcting certain mechanical errors, such as the linearity (1 µm theoretical vs. 0.99955 µm real) and the backlash in reverse directional changes (see BA command in Section "Command Descriptions"). By configuring the physical parameters of the mechanism in this way, axial displacements become easier to program and the results more precise.

The user's program always remains unchanged even when the mechanism itself changes, for example, when an axis is replaced by a higher performance one (1 µm ➡ 0.1 µm) or a completely different type (1 µm ➡ interferometer with 0.039552 µm).

The MM 4000 Controller is equipped with its own integrated motor power boards. Information about these boards is given in Section "Appendix D. Motor Power Boards".

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DISPLACEMENTS

Each displacement has three movements: an acceleration, an interval of constant speed, and a deceleration having the same absolute value as acceleration. The durations of the first and third events are identical and depend on the accelerations and speeds of the different axes acting in the displacement.

In linear interpolation mode, the speeds and the accelerations for all the axes are calculated by the controller, and the displacements start and stop at the same time on all axes. During these displacements the speeds and accelerations correspond to the stored physical parameters for the axes. In non-synchronized mode, each axis moves independently according to its own parameters. For the latter mode, the total time of displacement will be penalized by the slowest axis or the axis that travels the greatest distance.

***Important:** Whenever the controller encounters an end-of-travel, it stops to indicate an abnormal system operation. In this state further automatic displacements cannot be made. To exit this blocked condition, either switch to manual mode or request an origin search.*

ORIGIN SEARCH

The origin position is reached after two consecutive signals are detected as the axis moves in a given direction and speed. The first is a logical signal from a sensor, called mechanical zero, followed by the index pulse signal. If no index pulse signal is present, the controller then detects only the high level on the mechanical zero signal and stops.

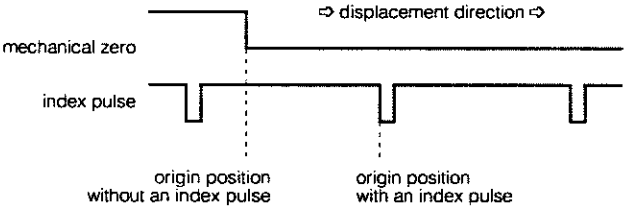


***Fig. 1**: The two signals used in origin search.*

Note

If during an origin search the + end-of-travel is sensed, the search halts, and the controller executes an emergency stop. During the search, the motion always occurs in the same direction and at the same speed to assure the best repeatability.

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MM 4000 DESCRIPTION & INSTALLATION

FRONT PANEL

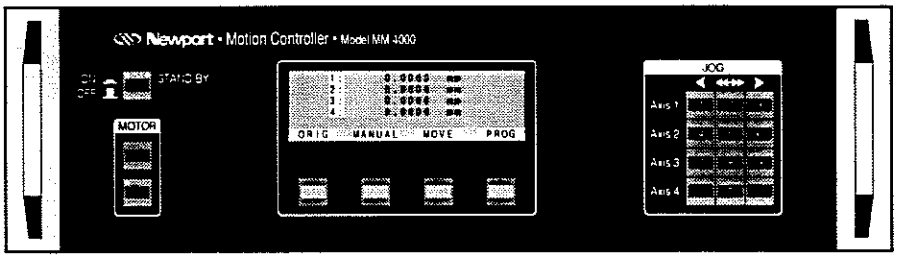


Fig. 2: Front panel of the MM 4000 Controller.

The front panel is shown in Fig. 2 and has the following features:

- *a push-button switch to power up the controller,*
- *two START/STOP push-button switches for the motors,*
- *A display with four push-buttons shows:*
  - *the general programming parameters, i.e., language, displacement type & mode, interface link, the origin search sequence, etc.,*
  - *the start and execution of programs,*
  - *the axes positions,*
  - *the axes states,*
  - *the programming menus.*
- *a 12-key pad for:*
  - *changing displayed parameter values,*
  - *axes displacements in manual mode,*
  - *axes displacement in automatic mode (indexing in absolute or relative mode).*

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BACK PANEL DESCRIPTION

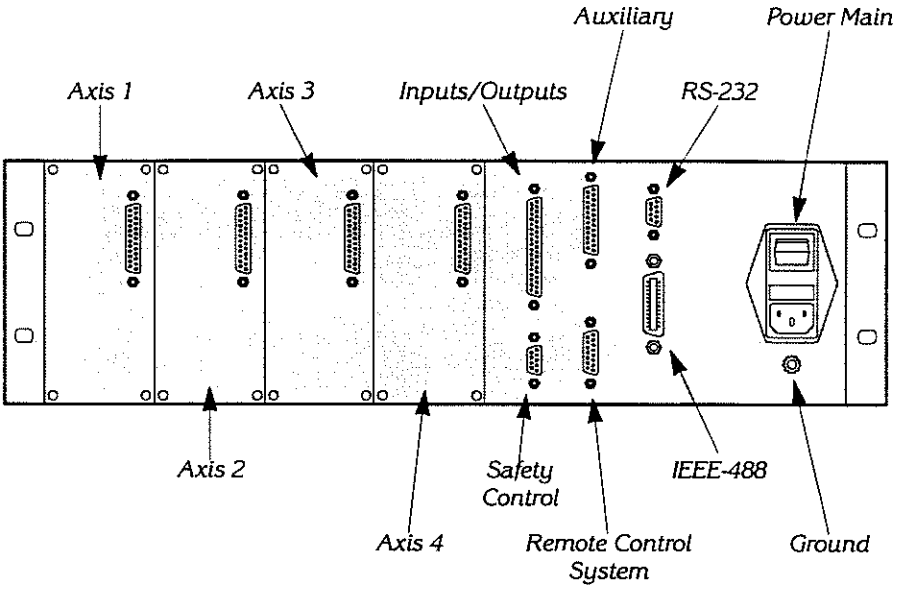


Fig. 3: Back panel of the MM 4000 Controller.

⚠ WARNING

USE EXTREME CAUTION WHEN USING THE "SAFETY CONTROL" AND "REMOTE CONTROL SYSTEM" CONNECTORS.

CONTACT NEWPORT/KLINGER BEFORE CONNECTING THEM.

The back panel is shown in Fig. 3 and has the following connections as described below.

LABELLING CONVENTIONS

- **0V.L.** ⇨ *0 volt logic;*
- **N.C.** ⇨ *Not connected;*
- **UTIL** ⇨ *Used for checkout; **DO NOT USE**;*
- **I.** ⇨ *Input;*
- **O.** ⇨ *Output.*

The Emergency Stop can be initiated by the program or by an Emergency Stop signal as indicated below.

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9-PIN, SUB-D SAFETY CONTROL CONNECTOR

(Be very careful not to mismatch these pinout signals).

1 – Ground

2 – I. ARM. Corresponds to the green button on the front of the joystick when it is connected to the 0V.L. Do not connect this during normal controller operation.

3 – I. ES Emergency Stop, must always be connected to 0V.L. during normal controller operation.

4 – N.C.

5 – N.C.

6 – 0V.L.

7 – 0V.L.

8 – 0V.L.

9 – N.C.

15-PIN SUB-D REMOTE CONTROL SYSTEM AND ANALOG INPUT CONNECTOR

(In the MM 4000 this connector is used only for analog inputs).

1 – Ground

2 – AU1 } *Corresponds to the red power button*

3 – AU2 } *on the front panel.*

4 – ARM Corresponds to the green motor button on the front panel.

5 – I.G/D Analog input 1.

6 – I.H/B Analog input 2.

7 – LED

8 – LED power

9 – 0V.L.

10 – 0V.L.

11 – 0V.L.

12 – 0V.L.

13 – 0V.L.

14 – 0V.L.

15 – Power

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25-PIN SUB-D AUXILIARY CONNECTOR

These inputs/outputs are TTL compatible.

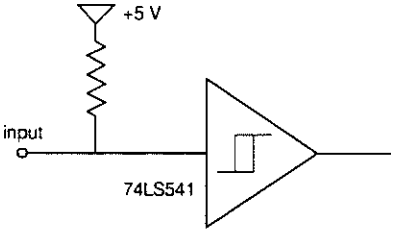


Fig. 4: Input diagram for the 25-pin Sub-D connector.

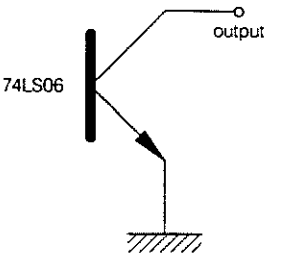


Fig. 5: Output diagram for the 25-pin Sub-D connector.

1 – *Ground*
2 – **UTIL**
3 – **I.** *DISA1* } *If one of these signals falls to 0V.L., the controller*
4 – **I.** *DISA2* } *stops as if by an Emergency Stop.*
5 – **I.** *ABORT* *If this signal falls to zero, it has the same effect as the AB (abort) command in TV Controller series or ST (stop) in standard commands.*
6 – **UTIL**
7 – **UTIL**
8 – **UTIL**
9 – **UTIL**
10 – **O.** *ON/OFF* *Output signal indicates whether or not the motors are powered (Like the green LED on the front panel or on the joystick).*
11 – **O.** *Stage* *Stage speed signal.*
12 – **UTIL**
13 – **UTIL**
14 – **0V.L.**
15 – **0V.L.**
16 – **0V.L.**
17 – **0V.L.**
18 – **0V.L.**
19 – **0V.L.**
20 – **0V.L.**
21 – **0V.L.**
22 – **0V.L.**
23 – **0V.L.**
24 – **O.** *Synchro.* *Output frequency defined by the standard FT command.*
25 – **UTIL**

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37-PIN SUB-D INPUT/OUTPUT CONNECTOR

These inputs/outputs are TTL compatible.

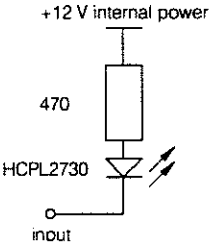


Fig. 6: Input diagram for the 37-pin Sub-D connector.

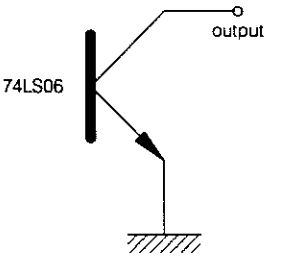


Fig. 7: Output diagram for the 37-pin Sub-D connector.

1 – Ground	*20 – **0V.L.***
2 – +12 V, 25mA	*21 – **0V.L.***
3 – +5 V, 100mA	*22 – **0V.L.***
4 – Input 1	*23 – **0V.L.***
5 – Input 2	*24 – **0V.L.***
6 – Input 3	*25 – **0V.L.***
7 – Input 4	*26 – **0V.L.***
8 – Input 5	*27 – **0V.L.***
9 – Input 6	*28 – **0V.L.***
10 – Input 7	*29 – **0V.L.***
11 – Input 8	*30 – **0V.L.***
12 – Output 1	*31 – **0V.L.***
13 – Output 2	*32 – **0V.L.***
14 – Output 3	*33 – **0V.L.***
15 – Output 4	*34 – **0V.L.***
16 – Output 5	*35 – **0V.L.***
17 – Output 6	*36 – **0V.L.***
18 – Output 7	*37 – **0V.L.***
19 – Output 8	

25-PIN SUB-D AXES MOTOR INTERFACE CONNECTORS

For the pinouts of this connector refer to Appendix D.4.

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CONNECTION TO A HOST COMPUTER

The MM 4000 controller can communicate with a host computer via its RS-232 or IEEE-488 connector. The type of link and the parameters for the communication must be correctly configured. The type and format of the exchanged messages are also a function of the parameters of the chosen controller. Refer to section "Configuring the Axes" for more details. The controller has an input buffer and an output buffer, each with 4096 characters. A single message, however, may not exceed 256 characters.

RS-232 C LINK

The RS-232 C Link uses a 9-pin Sub-D connector.

The back panel connector pin-out is given below in Fig. 8:

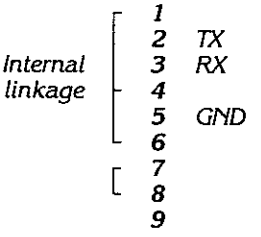


***Fig. 8**: Connector pin-out for the 9-pin Sub-D connector.*

RS-232 C CABLE LINK

The connection diagrams for the RS-232 C below show the possible pin-outs between the controller and the host computer.

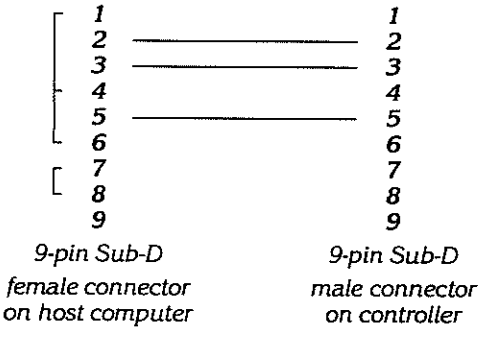
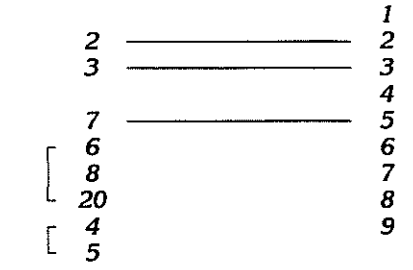


***Fig. 9**: Example of a minimum RS-232 C cable link between the controller and a host computer equipped with a 9-pin Sub-D connector.*

Note

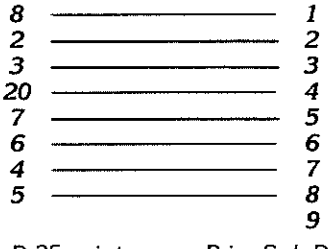
Since the wiring points have already been made inside the controller, any ordinary 9-point wire-to-wire cable & connector will work.

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25-pin Sub-D female connector on host computer — *9-pin Sub-D female connector on controller*

a - *One cable example.*



Prise Sub-D 25 points femelle côté ordinateur — *Prise Sub-D 9 points femelle côté contrôleur*

b - *Second cable example.*
The wiring points have already been made inside the controller so this cable above works just as well as the cable in **a**.

***Fig. 10**: Examples of a minimum RS-232 C cable link between the controller and a host computer equipped with a 25-pin Sub-D connector.*

NOTE

The RS-232 port requires only 3 wires. You should verify that the assembly (computer + software) receiving the messages sent by the controller is able to receive them at the transmission speed given in the controller's configuration. If not, either reduce the transmission speed or limit the volume of messages asking the controller for information, e.g., have the controller make the necessary pauses between messages (refer to the WT command).

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IEEE-488 LINK

The IEEE-488 link complies with IEEE Standard 488-1978.

IEEE-488 Cable

The IEEE-488 cables (GPIB) can be ordered from your nearest Newport/Klinger sales & service office.

Note

The MM 4000 Controller manages the "serial poll" (refer to IEEE standards concerning SPOLL, SRQ, and IEEE-488). The serial poll lets the host computer quickly know if the controller wants to transmit information to it and lets it interrogate the controller at its own rate. If, however, after a request for information from the computer, the controller, having responded with an SRQ, has not been interrogated at the end of the delay programmed in its configuration, a time-out error is issued. The error message is displayed as: "Communication TimeOut" (refer to TB command).

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MM 4000 OPERATION

GENERAL

The Newport/Klinger system you have received has already been entirely configured for parameters and tested. The system includes the following:

- *a mechanism composed of one or more axes,*
- *one or more power supplies to drive the axis motor(s),*
- *interconnection cables,*
- *the controller unit,*
- *a driver application program.*

All the components have been tested, including the connection cables.

A supplied diskette contains the driver software for the CONTROL.EXE controller and several system configuration files.

⚠ WARNING

TURN OFF ALL POWER
TO THE MM 4000 CONTROLLER
AND ITS ATTACHED ELECTRONICS
BEFORE CONNECTING OR DISCONNECTING CABLES.

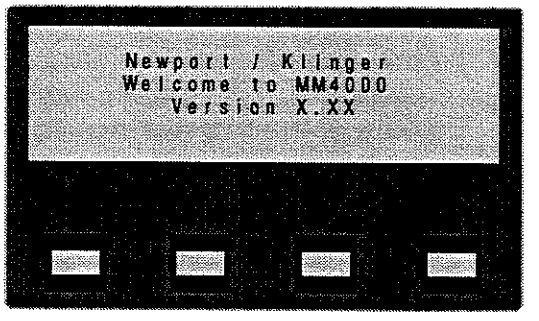
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START UP

1 *Interconnect the power supplies and motors. Verify that each cable correctly corresponds to its motor.*

2 *Switch on the main power from the back panel.*

3 *Switch on the controller power by pressing the button marked Standby at the top left of the front panel. After several seconds the following message will appear on the controller display: "Newport/Klinger. Welcome to MM 4000 Version X.XX".*



The X.XX corresponds to the controller's software version number. Always give this number when contacting Newport Corporation. After several more seconds, a display showing the axes and their units will appear on the screen.

4 *Start the axes system by pressing the green pushbutton labeled ON at the bottom left of the front panel.*

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FRONT PANEL OPERATION

The front panel functions allow you to perform the following actions:

- *Configure the controller's parameters,*
- *Perform mechanical origin searches on the axes,*
- *Perform displacements in manual mode,*
- *Perform displacements (absolute or relative) in automatic mode,*
- *Display the axial positions or states (end-of-travel sensor, mechanical zero, default, etc.)*

In addition, programming is made simpler because the user merely responds via the menu buttons and keypad to controller requests for information shown on the display.

FRONT PANEL DISPLAY

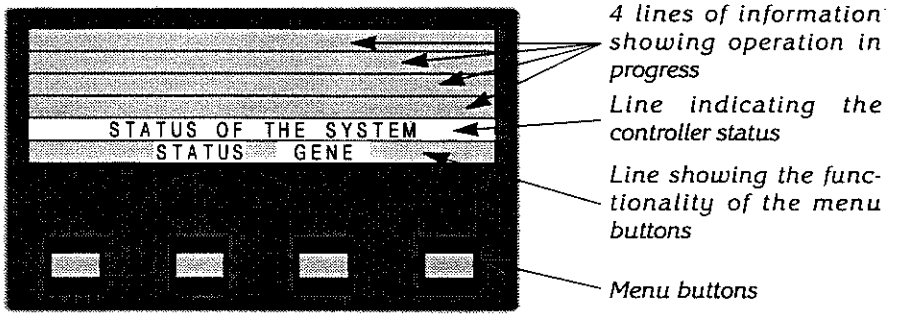


Fig. 11: *Display diagram.*

KEYPAD

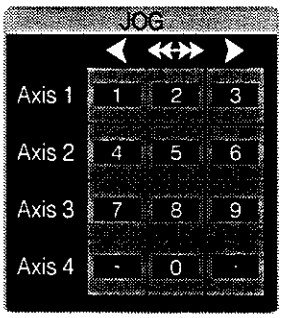


Fig. 12: *Keypad diagram.*

The keypad can do the following functions:

- *Enter numerical values into the controller,*
- *Displace the axes in manual mode (forward, reverse, fast forward, fast reverse),*
- *Displace the axes in relative mode.*

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POWER-ON AND POWER-OFF BUTTONS FOR AXES MOTORS

These buttons are found at the front panel lower left on a separate panel, labeled MOTOR.



Fig. 13: Diagram of Motor Power Buttons.

STARTUP DISPLAY

On startup the display appears as shown below:

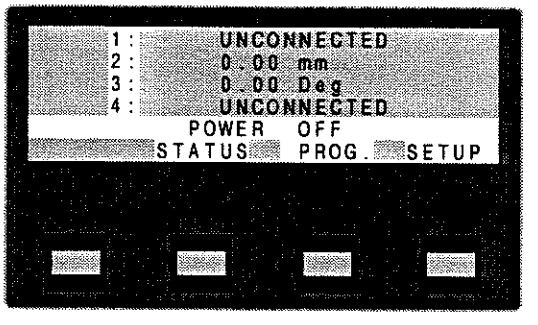


Fig. 14: Example of startup display.

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ACCESSING THE DISPLAY MENUS

SELECTING A MENU

To select a menu press the function button directly beneath it on the last display line.

SELECTING AN OPTION OR A VALUE FROM A LIST

In many menus you will have to choose an option. The menu option line appears as shown in Figure 15.

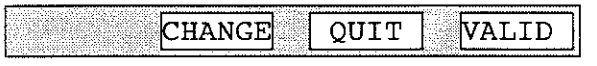


***Fig. 15**: Selecting an option.*

You can also scroll the option list by pressing CHANGE. When you are satisfied with your selection, press VALID to validate it. You can exit at anytime without entering a selection by pressing QUIT.

ENTERING A NUMERICAL VALUE

In many menus you will have to enter a numerical value. The menu option line will appear as follows:



***Fig. 16**: Entering a numerical value.*

Enter your value using the keypad's numerical keys. If you make a mistake you can erase the value digit by digit using the DELETE button. Press VALID to validate, or exit the menu without change by pressing QUIT.

The above are the three most frequently used functions on the display. Other possible functions available from the front panel of the MM 4000 controller are described in the subsections below.

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MENU DESCRIPTIONS

ORIGIN SEARCH

ON ORIG.

After selecting it, enter the axis number to perform an origin search on the axis.

MANUAL DISPLACEMENT

ON MANUAL

This menu item lets you displace the axes using the numerical keys on the keypad (see paragraph "Keypad"). For example if you want axis 1 to move in a positive direction at normal speed, press key "3". If you want axis 4 to move in the negative direction at normal speed, press key "–".

AUTOMATIC DISPLACEMENTS

Relative Displacement

ON MOVE RELAT.

This menu item lets you enter the relative displacement value for each axis. You can enter, for example, a displacement of 10 mm for axis 1; 5 mm for axis 2; 2 mm for axis 3; and 0 mm for axis 4. After input and validation of these values, the display will appear as shown in Fig. 17.

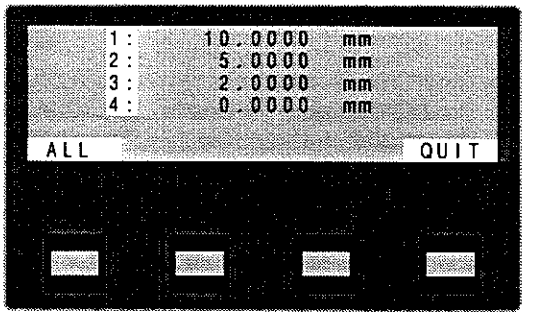


Fig. 17: Example of relative displacement display.

Two options are available to start the axial displacements:

1. *Start displacement of all axes at the same time by pressing the menu button ALL, or*
2. *Start one single axis by pressing the numerical key corresponding to the axis number, i.e., 1 for axis 1. You can reiterate the displacement as many times as you wish, as long as the cumulative movement stays within the allowed travel limit of the axes.*

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Absolute displacement

ON MOVE ABSOL.

This menu item lets you enter the absolute displacement value for each of the axes. You can enter, for example, a displacement of 10 mm for axis 1; 5 mm for axis 2; 2 mm for axis 3; and 0 mm for axis 4. After these inputs are validated, the display will appear as shown in Fig. 18.

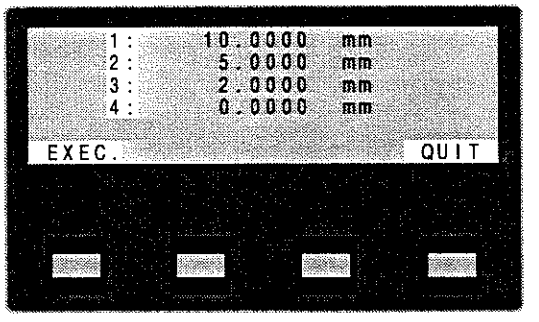


***Fig. 18**: Example of absolute displacement display.*

In this case the displacement starts on all axes at the same time when the EXEC button is pressed. To reiterate the displacement, you must again input the values to this menu item.

MM 4000 PROGRAMMING MODE

Launching a Program

ON PROG. EXEC.

This menu item allows you to launch a program stored in the controller's memory.

1 Enter the program number you wish to launch.

2 Enter the number of times you want the program to repeat.

The display will appears as shown in Fig. 19.

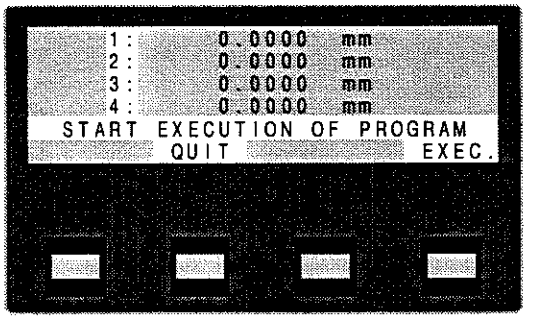


***Fig. 19**: Example of display in programming mode.*

Start program execution by pressing the EXEC button, or exit the menu without launching the program by pressing QUIT.

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Creating a Program Using the Front Panel

ON → PROG. → CREATE

The Create menu item allows you to write a program using the MM 4000 menu buttons. In this programming mode the sequence of selected commands execute only after the mode is exited and the Run command given. Refer to Section "Programming from the MM 4000 Front Panel" for more details.

Displaying a Program and Making Simple Modifications

ON → PROG → MODIFY

The Modify menu item allows you to list on the MM 4000 display the lines of a program present in memory and make basic modifications, such as erase a line, add a line of simple commands, etc. This menu selection, like Create discussed above, is part of the front panel programming mode available on the MM 4000. Refer to Section "Programming from the MM 4000 Front Panel" for more details.

CONFIGURING THE AXES

OFF → SETUP

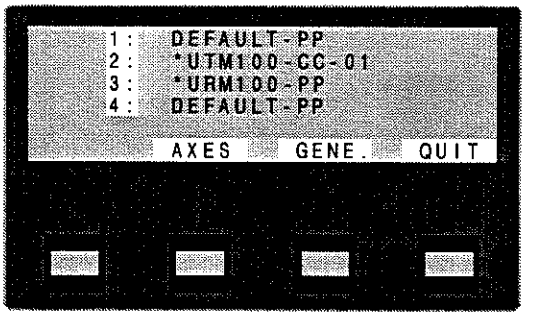


***Fig. 20**: Example of display in Setup menu.*

Select Axis for Setup

OFF → SETUP → AXES → AXIS #

- *Enter the axis number to be configured.*

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Initialize the Axis

OFF SETUP AXES SELECT

The menu display will show the number of the initialized axis and its name (component) as shown in Fig. 21.

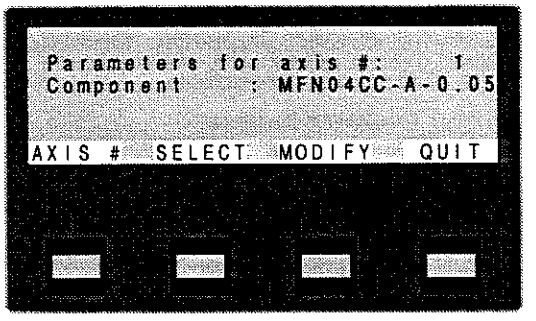


***Fig. 21**: Example of display in axis configuration mode.*

***Note**: If an asterisk appears in front of the component name, this means that the characteristics of the corresponding axis have been changed at least once since the axis left the factory.*

1 *Select component family:*
   - *MFN; UTM; UTS; UZS; UZM; MTL; URM80; URM100; UBG50; UBG80; UBG120.*

2 *Select component:*
   - *MFN8-PP; MFN8-CC; MFN25-PP; MFN25-CC;*
   - *UTM25-PP-0.1; UTM25-PP-1-HL; UTM25-CC-1-HL; UTM25-CC-0.1; UTM50-PP-0.1; UTM50-PP-1-HL; UTM50-CC-1-HL; UTM50-CC-0.5-HA; UTM50-CC-0.1; UTM100-PP-0.1; UTM100-PP-1-HL; UTM100-CC-1-HL; UTM100-CC-0.5-HA; UTM100-CC-0.1; UTM150-PP-0.1; UTM150-PP-1-HL; UTM150-CC-1-HL; UTM150-CC-0.5-HA; UTM150-CC-0.1;*
   - *UTS20-PP-0.1-D; UTS20-PP-0.1-F; UTS20-PP-1-D; UTS20-PP-1-F; UTS20-CC-0.1-D; UTS20-CC-0.1-F; UTS20-CC-1-D; UTS20-CC-1-F;*
   - *UZS80-PP-0.1; UZS80-CC-0.1;*
   - *UZM160-PP-0.1; UZM160-CC-0.1;*
   - *MTL100-PP-0.1; MTL100-PP-1; MTL100-PP-2.54; MTL100-CC-1; MTL100-CC-0.1-HA; MTL150-PP-0.1; MTL150-PP-1; MTL150-PP-2.54; MTL150-CC-1; MTL150-CC-0.1-HA; MTL200-PP-0.1; MTL200-PP-1; MTL200-PP-2.54; MTL200-CC-1; MTL200-CC-0.1-HA; MTL250-PP-0.1; MTL250-PP-1; MTL250-PP-2.54; MTL250-CC-1; MTL250-CC-0.1-HA;*
   - *URM80-PP; URM80-APP; URM80-CC; URM80-ACC; URM100-PP; URM100-APP; URM100-CC; URM100-ACC;*
   - *UBG50-PP; UBG50-CC; UBG80-PP; UBG80-CC; UBG120-PP; UBG120-CC.*

3 *Select the travel, depending on the selected axis.*

4 *Select the origin position, depending on the selected axis.*

5 *Enter the Kp control coefficient value.*

6 *Enter the Ki control coefficient value.*

7 *Enter the Kd control coefficient value.*

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Modifying the axis parameters

OFF → SETUP → AXES → MODIFY

The display resembles Fig. 21 above. In this menu you can modify parameters linked specifically or generally to the axis as listed below.

- *The units of measure:*
  - *mm, µm, Inch, mInch, µInch, degrees, grad, radians, µradians.*
- *Type of displacement:*
  - *real or simulated.*
- *Type of origin:*
  - *real or forced.*
- *Type of motor:*
  - *stepper or DC.*
- *Type of control loop:*
  - *closed or open.*
- *Type of encoder:*
  - *simulated or external.*
- *Motor step value.*
- *Maximum speed.*
- *Displacement speed.*
- *Manual mode speed.*
- *Origin search speed.*
- *Acceleration.*
- *Minimum position.*
- *Maximum position.*
- *Origin position.*
- *Ki control coefficient.*
- *Kp control coefficient.*
- *Kd control coefficient.*
- *Maximum tracking error.*

MODIFYING THE AXES PARAMETERS

In case of a problem, the axis parameters can be reloaded from the EZ_CONT.EXE program. To do this, do the following:

1. *Configure your controller in MM 5000 mode (refer to section "Configuring the General Parameters" below).*
2. *Launch the EZ_CONT.EXE program which has been supplied on the diskette.*
3. *Enter the LOW LEVEL FUNCTIONS menu by simultaneously pressing keys [CTRL] and [F10].*
4. *Select CONTROLLER INITIALIZATION menu item to load the desired axes parameters via the communications link. Press the [ENTER] key to send the parameters (or press [ESC] to exit). These parameters are now saved permanently in backup memory.*
5. *Exit the LOW LEVEL FUNCTIONS menu by pressing the [ESC] key.*

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CONFIGURING THE GENERAL PARAMETERS



1 *Select language:*
   - *French, English, Japanese.*

2 *Select controller type:*
   - *standard or MM 5000.*

3 *Enter percentage of automatic speed.*

4 *Enter time-out value for the link.*

5 *Enter time-out value during origin search.*

6 *Select termination type:*
   - *LF, CR, CR/LF, LF/CR.*

7 *Select the communication type:*
   - *IEEE-488 or RS-232.*

   If communication link is IEEE-488:

      a *Select SQR utility:*
         - *Yes or No.*
      b *Enter the address of the device.*

   If communication link is RS-232:

      a *Select the transmission speed:*
         - *1200, 2400, 4800, 9600, 19200.*
      b *Select the parity:*
         - *none, even, odd.*
      c *Select transmission word length:*
         - *7 or 8.*
      d *Select number of stop bits:*
         - *1 or 2.*

8 *Enter the first axis number in the origin sequence (e.g., axis 3).*

9 *Enter the second axis number in the origin sequence.*

10 *Enter the third axis number in the origin sequence.*

11 *Enter the fourth axis number in the origin sequence.*

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MOTOR STATUS

Many menus contain the motor STATUS item. When you select it the display appears as shown in Fig. 22.

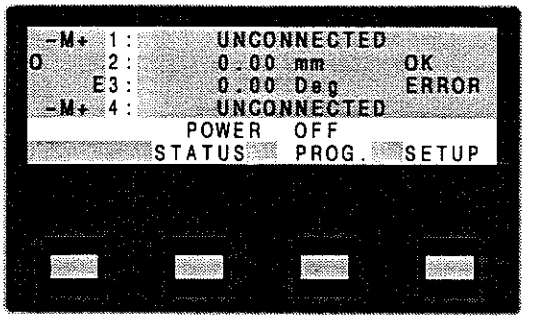


***Fig. 22:** Example of the STATUS menu.*

If you re-select the STATUS menu, you return to the previous display, which in this example is shown in Fig. 23.

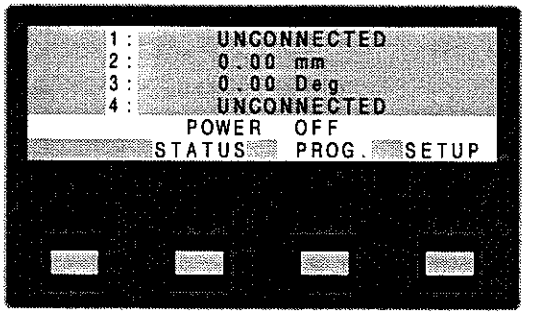


***Fig. 23:** Example without the STATUS menu.*

The display shows the motor status using the following notation:

- *If the controller has already performed one origin search or forcing on the axis, an "O" appears on the line of the axis concerned;*
- *If the axis is at its positive end-of-travel, a "+" sign appears;*
- *If the axis is at its negative end-of-travel, a "–" sign appears;*
- *If the controller sees the mechanical zero sensor on the axis at the current position, an "M" appears;*
- *If the controller sees an error, an "E" appears.*

The axis status can have any of the following notations (in order of their priority):

- ***ERROR:** The axis in closed-loop has exceeded its maximum allowed error.*
- ***FAULT:** A fault in the motor power boards has been detected.*
- ***OK:** No problem detected.*

***Note:** This display is continuous but may be stopped if you re-select the STATUS menu.*

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SUMMARY OF MENU ITEMS

WITH MOTOR SWITCH ON



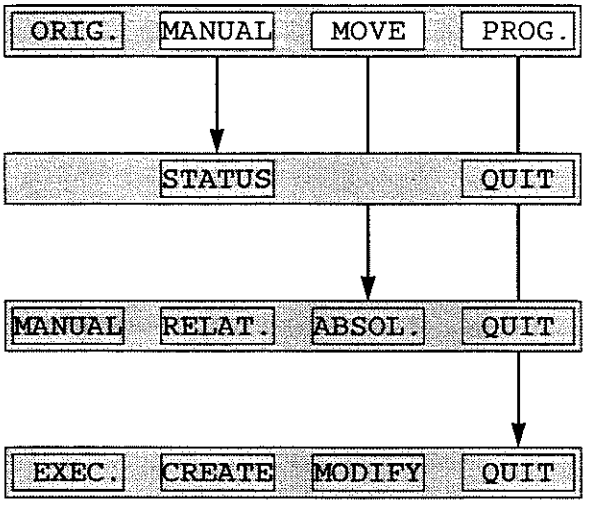


Fig. 24: Summary of available menu items and buttons when the motors are powered.

WITH MOTOR SWITCH OFF



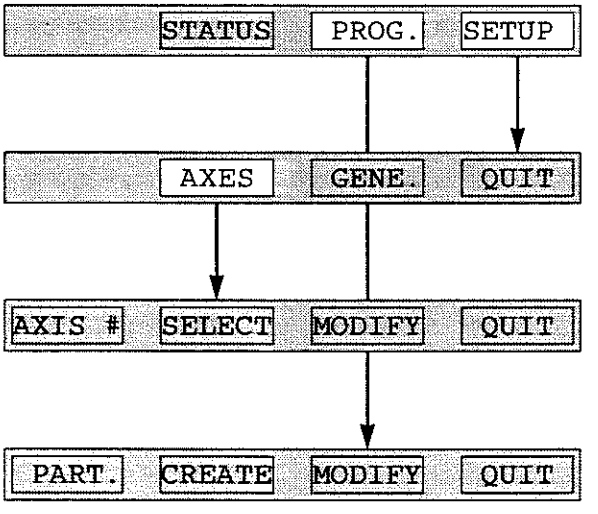


Fig. 25: Summary of available menu items and buttons when the motors are not powered.

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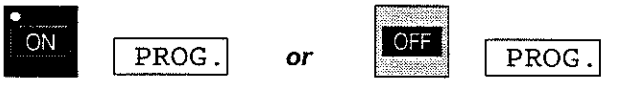
PROGRAMMING FROM THE MM 4000 FRONT PANEL

MM 4000 PROGRAM MANAGEMENT

The display, menu buttons, and keypad on the front panel of the MM 4000 let you do the following tasks in program management:

- *Run an existing program,*
- *Write a program and then save it in battery-powered RAM,*
- *Display a line-by-line listing of a program and modify it on the controller screen.*

ACCESSING THE PROGRAMMING MODE AND MENU



To access the front panel programming mode, press the menu button corresponding to PROG. on the screen. Either of two main programming menus will then be displayed depending on whether or not the motor power is ON or OFF:

- ***if OFF*** 

- ***if ON*** 

RUN A PROGRAM

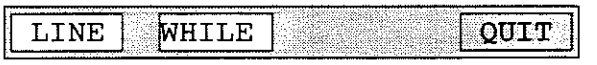
Pressing PART. in first menu above lets you partition RAM. This divides RAM into xx number of memory blocks (xx cannot exceed 64), according to the user's need. Each block corresponds to a program. Thus, xx is the program number, and also the block memory number occupied by the program. The total memory size available for the programs is 30 koctets. The size of a program is therefore 30/xx koctets. Backup memory is also completely cleared and repartitioned which means ***all the data there will be lost.***

Pressing the EXEC in the second menu above starts execution of a program that already exists in RAM. Refer to paragraph "Launching a Program" for more details.

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CREATE A PROGRAM

Pressing the CREATE menu button lets you start writing a program from the MM 4000 front panel. A menu will appear with the following programming selections:



These selections do the following:

LINE : lets you write a line-by-line command series,

WHILE : lets you write a loop. The loop is a WHILE type whose test can be either the number of times the loop executes or the logic state of an input (high or low).

MODIFY A PROGRAM

Pressing the MODIFY menu button and giving a program number of the program in RAM, lets you display it line-by-line. You can scroll through the program listing using the menu buttons under the screen. For further information on this function refer to paragraph "MM 4000 Programming Mode – Displaying a Program and Making Basic Modifications".

WRITING A PROGRAM FROM THE FRONT PANEL

This section explains how to create, write, and run a program from the front panel of the MM 4000 Controller.

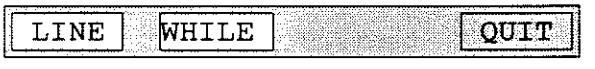
STARTING A NEW PROGRAM



To begin writing a program from the front panel of the MM 4000, press the following menu button sequence: PROG, CREATE.

The controller will ask you to enter a number for this new program. The program will be identified and recalled by this number, instead of a name. If this number has already been assigned to another program in the controller's memory, the controller will ask you if you want to erase the program already in memory and replace it by the new program you will create.

After you validate the identifying program number, the controller displays the programming menu showing selections LINE, WHILE, and QUIT.



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WRITING A COMMAND LINE

To write a line-by-line command program, press LINE which will then display an array of command selections such as Origin Search, Relative Displacement, Absolute Displacement, etc. in a menu (refer to section "Menu Summary for Writing a Program"). Select a desired command and then validate it with the menu buttons; this enters a program line and returns you to the command menu array, ready for you to select and input the next command line. The previous line appears on the screen, displaying the commands validated. When you want to end and exit this line-by-line programming, press Quit in the command array. This returns you to the first programming menu selection.

LINE (Standard Mode)

LINE

Selecting Function with the menu buttons lets you write commands one after another in line sequence.

Example:

1OR;
2OR;
1PA100;
WA1;

Note: For the explanations of the commands, refer to the Section "Command Descriptions".)

WRITING A WHILE LOOP

A program is principally a series of command lines and loops. A loop can consist of several lines. Before writing a loop in your program, decide on the type of test you will use to exit the loop, i.e., number of executions or logic input. After this, press WHILE in the first programming selection menu to display an array of loop commands and proceed to write a loop in the same manner as in paragraph "Writing a Command Line" above (also refer to section "Menu Summary for Writing a Program"). When you are done writing the loop and have validated it, exit by pressing Wend in the loop array menu which returns you to the first programming menu, i.e., LINE, WHILE, QUIT.

WHILE (Loop mode)

WHILE

Selecting the Loop menu button lets you integrate sequences of commands which will loop a finite number of times.

Example:

1YS0;
1WY1;
Sequence of commands
WE;

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EXITING THE PROGRAM WRITING MODE

QUIT

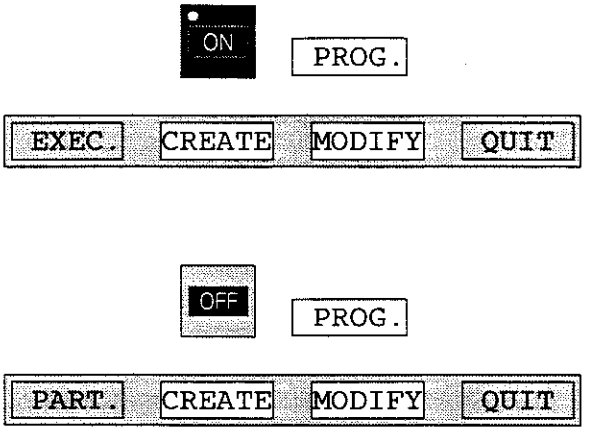
To exit the program writing mode, return to the first programming menu, i.e., LINE, WHILE, QUIT, and press Quit. This returns you to the program management menu, i.e.:

- *PART., CREATE, MODIFY, QUIT (for motors off), or*
- *EXEC., CREATE, MODIFY, QUIT (for motors on).*

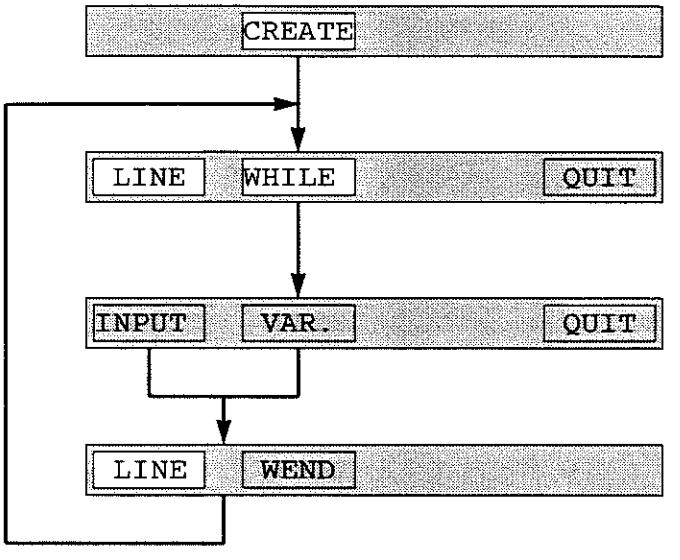
SAVING YOUR PROGRAM

Whenever you exit the program writing mode, the controller will ask you if you want to save the new program. If you select Yes, it will then save the program in battery-powered RAM for recall and execution later. A No response places the program in volatile RAM only where it can be executed or read from the front panel or over the link, but will be lost once the controller power is turned off.

MENU SUMMARY OF PROGRAMMING FROM THE MM 4000 FRONT PANEL

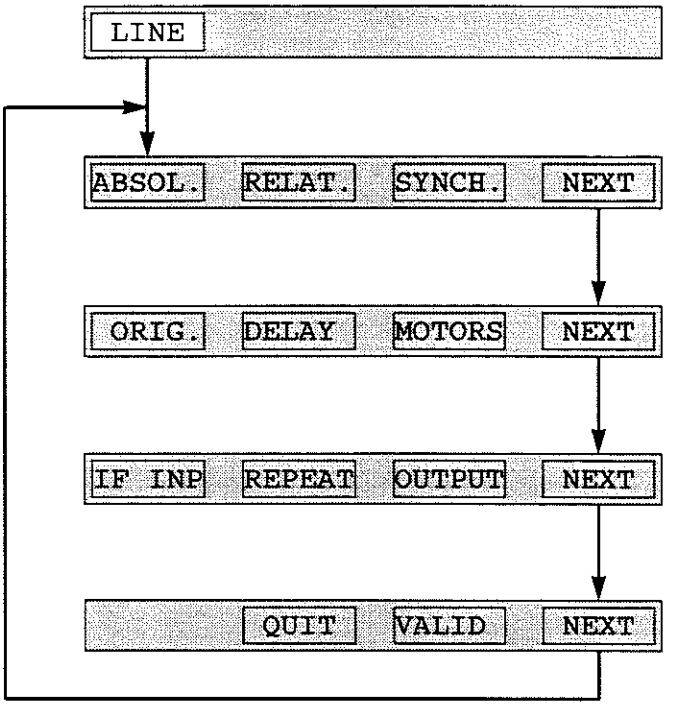


MENU SUMMARY FOR WRITING A PROGRAM

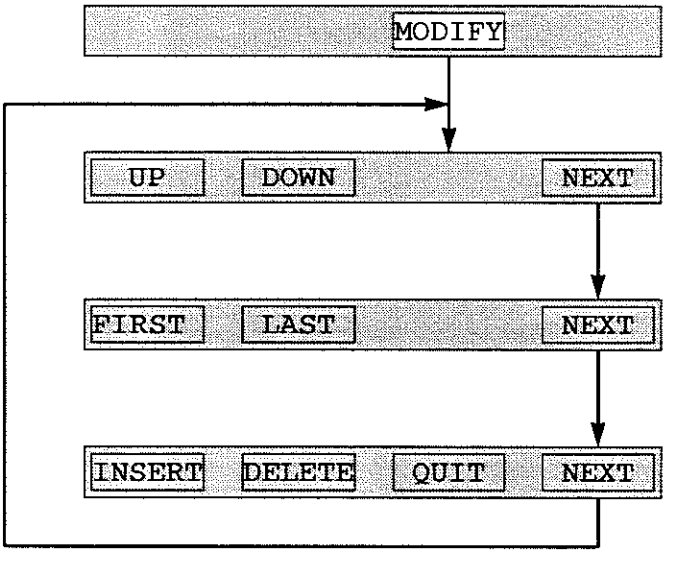


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MENU SUMMARY FOR DISPLAYING A PROGRAM AND MAKING BASIC MODIFICATIONS



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AVAILABLE COMMANDS IN MM 4000 PROGRAMMING MODE

ORIGIN SEARCH

ORIG.

Before starting an origin search, you must first enter an axis number. If you want to start an origin search on all axes, enter a zero value (0).

ABSOLUTE DISPLACEMENT

ABSOL.

Before entering an absolute displacement command, you must first enter an axis number. If you want to start an absolute displacement on all the axes, enter a zero value (0). The menu will then ask you to enter, one by one, the displacement value for each axis.

RELATIVE DISPLACEMENT

RELAT.

Before entering a relative displacement command, you must first enter an axis number. If you want to start a relative displacement on all the axes, enter a zero value (0). The menu will then ask you to enter, one by one, the displacement value for each axis.

SYNCH.

SYNCH.

The Synch. menu selection lets you invoke a pause in the program execution while one or all of the axes are moving.

DELAY

DELAY

With the Delay command you can invoke a pause of variable duration (milliseconds) in program execution.

IFINPUT

IF INP

The IFINPUT menu selection lets you choose a logical input condition in the program. It will execute a program line if the condition is true, e.g., input is HIGH. It must always appear at the beginning of a program line.

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CHANGING AN OUTPUT STATE

OUTPUT

The Output menu selection lets you force an output to a defined state (high or low) on execution of this command line.

REPEAT LINE

REPEAT

The Repeat Line menu selection lets you write a program line that will execute a finite number of times. (See RP command in Section "Command Descriptions"). BEG. RP lets you indicate the beginning of this line and END RP the end. RP must appear at the end of a line. It has no effect if the line is empty. RP will automatically validate the entire program line.

VALID

VALID

Pressing Valid validates the menu selection and exits the menu.

MODIFYING A PROGRAM ON THE DISPLAY

The Modify menu selection lets you list all the lines of a program stored in memory on the display.

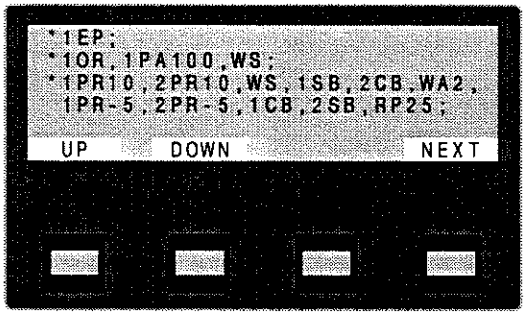


Fig. 26: *Example of Modify Program display.*

*The asterisk character "*****" is an important notation used in the display of program lines. It indicates the beginning of a program line. This is needed because the MM 4000 screen can only display 32 characters per screen line, and often a program line has more than 32 characters (but cannot exceed 255 characters). Here also, it is important to locate the beginning of a line, especially when using commands such as WY, RP, WE, UL, etc. All lines on the screen, therefore, that do not start with an asterisk indicate a continuation of the program line above it.*

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UP

The Up menu selection lets you scroll the lines toward the top of the display to select a line to modify, i.e., the line on the first screen line which must start with an "".*

DOWN

The Down menu selection lets you scroll the lines toward the bottom of the display to select a line to modify, i.e., the line on the first screen line which must start with an "" there.*

DELETE

The Delete menu selection lets you erase the first screen line (the line must start with an "" there). This selection erases the whole program line and not just the screen line. For the menu button to be active, the cursor must be on a line beginning with "*". All screen lines of the program line (preceded by a space and not an "*") will then be erased.*

FIRST

The First menu selection lets you display the beginning of the program.

LAST

The Last menu selection lets you display the end of the program.

INSERT

The Insert menu selection lets you insert a line of simple commands before the first displayed line which must begin with an "" there. The available commands are given in previous section.*

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PROGRAMMING WITH A HOST COMPUTER

HOST COMPUTER PROGRAMMING

In the programming mode using the MM 4000 communication link, users can write, compile, execute, and save programs via a host computer. As in MM 4000 front panel programming, these programs use the standard set of commands and are limited to a maximum total of 64 programs saved in MM 4000 memory (the actually number is varied with the PP command).

The MM 4000 uses two types of program memory:

- *Volatile memory (RAM) which loses its data when power is switched off. It is used for all manipulations (writing, reading, erasing, etc.).*
- *Backup memory (battery-powered RAM) which allows programs to be stored. It is inaccessible to the user.*

The size of each RAM is 30 koctets (see Fig. 27).

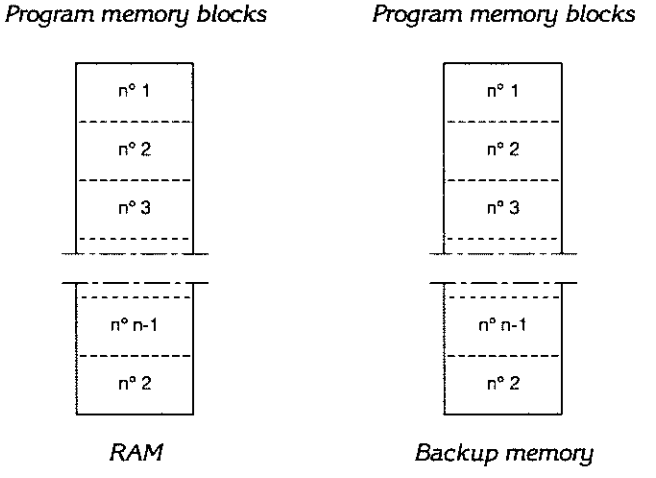


***Fig. 27**: The controller's program organization in RAM and in backup memory.*

Programs from a host computer can be loaded into controller memory when the communications link is active and the controller is in remote mode. Programs are written in RAM and are saved in backup memory using the SM command. This must be done before the system power is switched off, otherwise the programs will be lost. When power is switched on, the contents of backup memory is automatically loaded into RAM, ready for use.

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During the execution of a program, any error generated will immediately stop execution. The error can be displayed using either the TE or TB command. While a program is running, the user can interrogate the controller via the link (in EZ_COMM program terminal mode, for example). When an error is generated by a command sent via the link, it will not stop program execution and its error number will not be returned. Program commands take priority over commands sent via the link, except commands AB, MF, AP, ST, and RS which always have priority. For other communication in reduced link mode (refer to section "Command Validity for Each Mode"), the errors are correctly accepted and returned by the TE and TB commands.

COMMUNICATIONS SETUP

SERIAL PORT

This link requires only three wires (TX sending, RX receiving, and GND zero). The host computer must be capable of receiving all the characters sent by the controller at the speed defined in its configuration. If the host computer is too slow, you will need to either reduce the controller's sending speed or limit the rate of information demand messages (e.g., by adding pauses).

IEEE LINK

The MM 4000 controller manages communication using "serial poll" (refer to IEEE standards concerning SPOLL, SRQ, and IEEE-488). This function lets the host computer to quickly know when the controller wants to transmit information and interrogates the controller at its rate.

If, however, after a request for information from the host computer, the controller, having responded with an SRQ, has not been interrogated at the end of a delay programmed in its configuration, a time-out error is issued. The error message is displayed as: "Communication TimeOut" (see standard TB command).

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AXES PARAMETERS IN REMOTE PROGRAMMING MODE

To make the MM 4000 compatible with most other Newport/Klinger controllers, it should be configured to function in standard code (STANDARD). The message command syntax is shown in Fig. 28. Several commands can be sent in the same string, provided the string does not exceed 256 characters and the commands are separated by commas (,).

THE PARAMETERS

Certain parameters are unique to the axes. These were initialized by Newport/Klinger during controller checkout. The parameters loaded into the controller were also saved in the PARA directory on the diskette provided. This lets you reload them using the EZ_CONT.EXE program in case of a problem (refer to paragraph 3.5.6). These parameters, as they appear in the diskette files, are numbered and identified below. The double capital letters at the beginning of the line gives the standard command code used to modify the parameter.

	– (COM)	: Commentary
	– Simulation	: N or Y
	– Stepper motor	: N or Y
SC	– Closed loop	: N or Y
	– Encoder simulation	: N or Y
DH	– Origin forcing	: N or Y
	– Permanent axis	: N or Y
	– Encoder phase inc.	: value
	– Motor increment	: value
	– Max. speed	: value
VA	– Max. automatic speed	: value
	– Max. manual speed	: value
OH	– Max. origin search speed	: value
AC	– Max. acceleration	: value
SL	– Min. position	: value
SH	– Origin position	: value
SR	– Max. position	: value
	– Period	: value
KI	– Ki	: value
KP	– Kp	: value
KD	– Kd	: value
FE	– Max. error	: value

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AXES PARAMETER DEFINITIONS

Parameters can have the following variables:

- *Commentary, i.e., a character string,*
- *Y = TRUE, or N = FALSE*
- *Value, i.e., a numerical value.*

Simulation (N or Y)

Tells the controller if the axis is real or simulated. The variable Y is used in checkout. In your system it should be set to N.

Stepper motor (N or Y)

Tells the controller if the axis is stepper (Y) or DC motorized (N).

Closed loop (N or Y)

Tells the controller if the axis must be driven in closed loop (Y) or open loop (N).

Encoder simulation (N or Y)

Comment: Must be set to Y only when there is no encoder present for the stepper motor axis.

To control a stepper motor, the controller generates frequencies with a calculated period. The desired position will then be attained within the calculated error. If the axis has no encoder, it will be impossible for the controller to detect the calculation error. In this method the controller counts the number of pulses generated and then uses this value like an information encoder. Automatic control can also be performed in closed loop using this information. If the Encoder Stimulation is set to Y, then the Closed Loop parameter must also be set to Y, and the value of the Encoder Phase Increment parameter must be equal to the Motor Increment parameter.

Origin forcing (N or Y)

Tells the controller if it must force the origin (Y) or start an origin search (N) when it receives the origin search command for an axis.

Permanent axis (N or Y)

This parameter is not used by the MM 4000, but it must be present in the parameter files and sent to the controller. Its variable is disregarded and is included here only for compatibility with the TV controller series.

Encoder phase increment (value)

Defines the mechanical axis displacement value (in units specified by the user) for each encoder phase increment. All axis displacement calculations are based on this value.

Motor increment (value)

This parameter is used only for stepper-motor axes.

Defines the mechanical axis displacement value for each motor step, which is based on the generated pulse unit value given in the encoder phase increment parameter.

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Maximum speed (value)

Sets the maximum speed value (units per second) for the mechanism. This value lets you calibrate the analog voltage generated relative to the servo-drive (power electronics), used in DC motor control.

Maximum automatic speed (value)

Defines the maximum speed (units/second) of a mechanical axis in automatic displacement mode.

Maximum manual speed (value)

Defines the maximum speed (units/second) of a mechanical axis in manual displacement mode.

Maximum origin search speed (value)

Defines the maximum axis speed (units/second) during mechanical origin search.

Maximum acceleration (value)

Defines the maximum acceleration (units/second2) during displacement.

Minimum position (value)

Defines the minimum position (in units) of axis travel (left).

Origin position (value)

Defines the mechanical axis position after an origin search (or a forcing to origin).

Maximum position (value)

Defines the maximum position (in units) of axis travel (right).

Period for a permanent axis (value)

This parameter is not used by the MM 4000, but must be present in the parameter files and sent to the controller. The value will be disregarded; it is used here only for compatibility with the TV controller series.

Ki (value)

Defines the integral constant used in automatic control calculations (PID closed loop). The value must be between 0 and 1.

Kp (value)

Defines the proportional constant used in automatic control calculations (PID closed loop). The value must be between 0 and 1.

Kd (value)

Defines the derived constant used in automatic control calculations (PID closed loop). The value must be between 0 and 1.

Max. allowable error (value)

Defines the limit (in units) between the theoretical position and the actual position at each instant. If this limit is exceeded, the controller stops all displacements (with a deceleration phase) and cuts power to all motors.

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COMMAND AND RESPONSE MESSAGE SYNTAX

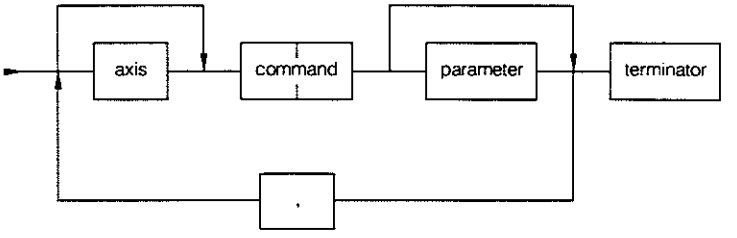


Fig. 28: Diagram of command message and response syntax.

NUMBER

A positive integer, which always comes before the command. It's presence in the string is optional. If it is not present in a command, it takes on the default value zero. It can represent several things:

- *In axes control, Number identifies the axis number.*
- *For analog input, Number is the channel number.*
- *For logic input/output, Number is the input or output number.*
- *In programming, Number identifies the program number.*
- *For variables which occur in tests, Number represents the running variable (Yval) number.*

COMMAND

Comprises two coded characters (AA to ZZ). A description of each command is given at the end of this section.

PARAMETER

Is sometimes present in the commands. It can be a real number corresponding to a displacement speed, an acceleration, or a test value for WHILE loops.

TERMINATOR

Indicates end of the message and is defined in the controller's configuration menu. It can be LF, CR, CRLF, or LFCR where LF = line feed and CR = carriage return.

IMPORTANT

The values for the mechanical axes parameters are not expressed in steps or increments, but in mechanical units. The unit has been previously defined by the user when the encoder phase increment parameter was initialized.

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LIST OF STANDARD COMMANDS

DISPLACEMENT

AB : Stops movement and power to the axes.
AC : Defines the acceleration for an axis.
MF : Stops movement and power to the axes.
MO : Switches on power to the axes.
OH : Defines origin search speed for an axis.
OR : Executes an origin search on an axis.
PA : Executes an absolute displacement on an axis.
PR : Executes a relative displacement on an axis.
SD : Defines displacement speed as a percentage of automatic speed.
ST : Stops displacement on all axes.
VA : Defines speed in automatic mode.

POSITIONING

BA : Defines backlash compensation for an axis.
DH : Executes origin forcing on an axis.
FE : Defines maximum instantaneous tracking error for an axis.
KD : Initializes the Kd derivative PID factor on an axis.
KI : Initializes the Ki integral PID factor on an axis.
KP : Initializes the Kp proportional PID factor on an axis.
SC : Defines the type of control loop for an axis (0 = open, 1 = closed).
SE : Starts movement for one or more synchronized axes.
SH : Defines origin position for an axis.
SL : Defines left displacement travel limit (–) for an axis.
SR : Defines right displacement travel limit (+) for an axis.
SU : Defines one or more synchronized axes.
UF : Updates the automatic control parameters Ki, Kp, Kd, and the max. instantaneous tracking error for an axis.

PROGRAMMING

AP : Stops program execution.
CP : Compiles a program.
EP : Activates programming mode.
EX : Executes a program.
LP : Rereads a program.
MP : Loads programs into memory.
PP : Partitions program memory.
QP : Exits programming mode.
SM : Saves a program in backup memory.
XX : Erases a program in backup memory.
YA : Adds a value to a variable.
YS : Initializes a variable.

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READING INFORMATION

DA : Reads acceleration on an axis.
DF : Reads instantaneous tracking error on an axis.
DP : Reads destination position on an axis.
DV : Reads automatic mode speed on an axis.
MS : Reads status of motor(s).
NP : Reads maximum number of programs.
RA : Reads analog input.
RB : Reads logic input.
TA : Reads axis name.
TB : Reads error explanation.
TC : Reads type of control loop.
TE : Reads error number.
TH : Reads theoretical position on an axis.
TL : Reads left limit (–) of an axis.
TN : Reads the defined units for the axis.
TP : Reads actual encoder position on an axis.
TR : Reads right limit (+) of an axis.
TS : Reads system status.
TT : Reads measurements of trace mode (refer to TM command).
TU : Reads the units (encoder phase increment) of an axis.
TY : Reads a variable Y.
VE : Reads the controller version.
XD : Reads the derivative coefficient Kd of an axis.
XF : Reads maximum tracking error of an axis.
XH : Reads origin position of an axis.
XI : Reads integral coefficient Ki of an axis.
XN : Reads the number of samples in last acquisition (trace mode).
XP : Reads proportional coefficient Kp of an axis.
XS : Reads the sampling period (trace mode).

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SEQUENCES

DL : *Defines a label.*
DS : *Displays an ASCII message.*
DI : *Displays a Y variable.*
IE : *Tests the equality of a logic input and a value (0 or 1).*
JL : *Jumps to a label.*
OE : *Tests the equality of a logic output and a value (0 or 1).*
RP : *Repeats a command line.*
UH : *Waits while a logic input is in its upper state.*
UL : *Waits while a logic input is in its lower state.*
WA : *Pauses.*
WE : *Exits the WHILE loops.*
WG : *WHILE Y is greater than the argument.*
WH : *WHILE the input is equal to the argument.*
WK : *Waits for keystroke from front panel.*
WL : *WHILE Y is less than the argument.*
WP : *Waits while an axis moves to its position value.*
WS : *Waits for displacement to stop, plus an extra time lapse.*
WT : *Pauses.*
WY : *WHILE Y does not equal the argument.*
YE : *Tests the equality of a variable and a value.*
YG : *Tests for a variable greater than a value.*
YL : *Tests for a variable less than a value.*

OTHERS

CB : *Resets a TTL output to zero.*
FT : *Output frequency.*
MC : *Activates manual mode.*
ML : *Activates local mode.*
MR : *Activates remote control mode.*
PW : *Saves axis parameters in backup memory.*
RS : *Reinitializes controller CPU.*
SB : *Resets TTL output to one.*
SP : *Initializes sampling period (trace mode).*
TG : *Inverts a TTL output.*
TM : *Activates trace mode.*

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COMMAND VALIDITY FOR EACH MODE

Generally commands are valid only for specific controller modes. These are outlined and described below:

LINK MODE

The MM 4000 is remotely controlled via the communications link; no program is being executed; and the functions CONFIGURATION, MANUAL MODE, and INDEXING on the front panel are not in use. The transmitted commands in this mode are immediately executed.

PROGRAMMING MODE

This is the program writing mode. Authorized commands are those that can be put into a program. The EP command received via the link starts the programming mode, and the commands transmitted are placed line by line into the program. If a non-authorized command is received in this mode, the compilation (CP) and execution (EX) will signal an error. The QP command quits the programming mode.

REDUCED LINK MODE

In this mode the MM 4000 executes priority tasks. At any time, the user can either interrogate the controller via the link to recuperate information such as its status, states of the axes, input/output values, variable values, errors, axes parameters (i.e., read information commands), etc., or stop execution with commands AB, MF, AP, ST, or RS.

These priority tasks can be:

- *Executing a program*
- *Operating in manual mode (refer to paragraph "Manual Displacement").*
- *Operating in indexing mode (refer to paragraph "Automatic Displacements").*
- *Executing commands WP, WS, and OR.*

SUMMARY OF COMMAND/MODE VALIDITY

The table (next pages) shows which commands are valid (check mark) for each mode.

A single check mark ✓ indicates the command is valid for the mode; a double check mark ✓✓ indicates that the command is valid only during program execution.

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Command	Link Mode	Programme Mode	Reduced Link Mode
DISPLACEMENT			
AB	✓	✓	✓
AC	✓	✓	
MF	✓	✓	✓
MO	✓	✓	
OH	✓	✓	
OR	✓	✓	
PA	✓	✓	
PR	✓	✓	
SD	✓	✓	
ST	✓	✓	✓
VA	✓	✓	
POSITIONING			
DH	✓	✓	
FE	✓	✓	✓
KD	✓	✓	✓
KI	✓	✓	✓
KP	✓	✓	✓
SC	✓	✓	
SE	✓	✓	
SH	✓	✓	
SL	✓	✓	
SR	✓	✓	
SY	✓	✓	
UF	✓	✓	✓
BA	✓	✓	
PROGRAMMING			
AP	✓	✓	✓
CP	✓		
EP	✓		
EX	✓		
LP	✓		✓
MP	✓		
PP	✓		
QP	✓		
SM	✓		
XX	✓		
YA	✓	✓	
YS	✓	✓	

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Command	Link Mode	Programme Mode	Reduced Link Mode
READING INFORMATIONS			
DA	✓	✓	✓
DF	✓	✓	✓
DP	✓	✓	✓
DV	✓	✓	✓
MS	✓	✓	✓
NP	✓	✓	✓
RA	✓	✓	✓
RB	✓	✓	✓
TA	✓	✓	✓
TB	✓	✓	✓
TC	✓	✓	✓
TE	✓	✓	✓
TH	✓	✓	✓
TL	✓	✓	✓
TN	✓	✓	✓
TP	✓	✓	✓
TR	✓	✓	✓
TS	✓	✓	✓
TT	✓	✓	✓
TU	✓	✓	✓
TY	✓	✓	✓
VE	✓	✓	✓
XD	✓	✓	✓
XF	✓	✓	✓
XH	✓	✓	✓
XI	✓	✓	✓
XN	✓	✓	✓
XP	✓	✓	✓
XS	✓	✓	✓

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Command	Link Mode	Programme Mode	Reduced Link Mode
SEQUENCES			
DL	✓	✓	
DS		✓	✓✓
DY		✓	✓✓
IE	✓	✓	
JL		✓	
OE	✓	✓	
UH		✓	
UL		✓	
WA	✓	✓	
WE		✓	
WG		✓	
WH		✓	
WK		✓	
WL		✓	
WP	✓	✓	
WS	✓	✓	
WT	✓	✓	
WY		✓	
YE	✓	✓	
YG	✓	✓	
YL	✓	✓	
OTHERS			
CB	✓	✓	
FT	✓	✓	
MC	✓	✓	
ML	✓	✓	
MR	✓		
PW	✓	✓	
RS	✓	✓	✓
SB	✓	✓	
SP	✓	✓	
TB	✓	✓	
TM	✓	✓	

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COMMAND DESCRIPTIONS

COMMAND DESCRIPTIONS

Comment

The controller recognizes 16 variables whose values can range from -32767 to +32767. These variables are systematically named 01Y to 16Y. The program numbers range from 1 to the maximum number of programs. Label numbers range from 1 to 32.

AB

Function : *Stops movement and power to the axes.*

This forces an emergency stop, and therefore halts all displacements in progress with a short deceleration and then a power cut. This command should be used with caution.

Syntax : *AB*

Warning: This command acts simultaneously on all valid axes.

⚠ *!! USE WITH CAUTION.*

Example : *AB*

Response : *None.*

AC

Function : *Defines the acceleration.*

Syntax : *xxACval where xx is the axis number and val the desired acceleration.*

A new acceleration value may be sent while a move is in progress.

Associated errors:

- *Incorrect axis number (error B).*
- *Parameter exceeds limit (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1AC20 ☞ Programs an acceleration of 20 units/sec² on axis 1.*

Response : *None.*

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AP

Function : *Stops program execution.*

Syntax : *AP*

This stops program execution via the exterior link or from within the program itself. This command does not stop a displacement already in progress. There are no associated errors.

Example : *AP*

Response : *None.*

BA

Function : *Defines axis backlash.*

Syntax : *xxBAval where xx is the axis number and val the backlash value (in units).*

This defines the backlash (mechanical play) for a mechanical axis. The backlash value may not exceed 100 encoder phase increments. The controller will compensate for the stated backlash on each reversal of displacement direction. This command is only valid if a search (or forcing to) origin has already been performed on the axis. It must be used only when the encoder phase increment matches that of the motor (and not in the case of a linear encoder). A displacement requiring less than the backlash value and a direction reversal will not be executed.

Associated errors:

- *Incorrect axis number (error B).*
- *Parameter exceeds limit (error C).*
- *Unauthorized execution (error D).*
- *Unauthorized command in reduced link mode (error Q).*

⚠ ***!! USE WITH CAUTION.***

Example : *1BA0.01 ☞ Defines a mechanical play of 0.01 unit on axis 1.*

Response : *None.*

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CB

Function : *Resets an output to zero.*

Syntax : *xxCB where xx is the TTL output number.*

This forces a TTL output to zero. xx must range from 1 to 8. If xx is null or non-existent, all outputs will be reset to zero.

Associated errors:

- *I/O channel number is incorrect (error E).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2CB ☞ Forces TTL output number 2 to zero.*

Response : *None.*

CP

Function : *Compiles a program.*

Syntax : *xxCP where xx is the program number.*

This verifies the syntax of a program. It checks for:

- *the validity of commands in execution mode,*
- *the position of tests on a command line,*
- *matching jumps with labels,*
- *ends for WHILE loops.*

Compilation stops at the end of a program or halts when an error is detected. At the end of the compilation, the first detected error is returned. If an error is detected, you must correct it and then recompile until no error is returned.

Comment: A program can be executed without being compiled by CP first; the program will be automatically compiled on execution. CP simply permits you to verify the program's syntax beforehand.

Associated errors:

- *Unauthorized command in reduced link mode (error Q).*

Example : *1CP ☞ Compiles program number 1.*

Response : *xxCPval where xx is the program number and val the error code. If val equals @, the compilation was successful, otherwise you must consult the error code using the TB command.*

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DA

Function : *Reads acceleration.*

Syntax : *xxDA where xx is the axis number.*

This reads the acceleration of an axis.

Associated errors:

- *Axis number incorrect (error B).*

Example : *2DA ☞ Reads the acceleration on axis number 2.*

Response : *xxDAval where xx is the axis number and val the acceleration.*

DF

Function : *Reads the instantaneous tracking error.*

Syntax : *DF or xxDF where xx is the axis number.*

Gives the difference, at any time, between the theoretical and actual axis position. The returned value is the value at the time the command was received. If xx is nonexistent or has a null value, the controller returns the instantaneous error on each axis.

Associated errors:

- *Axis number incorrect (error B).*

Example : *3DF ☞ Reads the instantaneous tracking error on axis 3.*

Response : *xxDFval where xx is the axis number and val the instantaneous error value, or 1DFval,2DFval in response to DF for a two-axes system.*

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DH

Function : *Forces an axis to origin.*

Syntax : *xxDH where xx is the axis number.*

This forces axis xx, or all axes if xx is omitted or equal to zero, to mechanical origin. The left (–) and right (+) software travel limit are recalculated to safely protect the equipment. The origin axis position parameter value may be changed using the SH command.

Associated errors:

- *Incorrect axis number (error B).*
- *Unauthorized execution (error D).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *4DH ☞ Forces axis 4 to its mechanical origin.*

Response : *None.*

DL

Function : *Defines a label.*

Syntax : *xxDL where xx is the label number (from 1 to 32).*

This defines a label which can then be used for a jump. In fact, you can go from one program line to another non-consecutive one, having defined a label beforehand with DL and jumping to this label using JL.

Associated errors:

- *Refers to an undefined label (error K).*
- *Command must be at the beginning of a line (error L).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *3DL ☞ Defines label 3.*

Response : *None*

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DP

Function : *Reads the position destination of an axis.*

Syntax : *DP or xxDP where xx is the axis number.*

This reads the previously assigned absolute position destination given by PA or PR. If xx is non-existent or is null, the controller returns the end position for each axis.

Associated errors:

- *Incorrect axis number (error B).*

Example : *3DP ☞ Reads the end position for axis 3.*

Response : *xxDPval where xx is the axis number and val the end position, or 1DPval,2DPval in response to DP for a two-axes system.*

DS

Function : *Displays an ASCII message.*

Syntax : *xxDSstring where xx is the display line number (1 or 2) and string is a ASCII message having a maximum of 14 characters.*

This displays a message on the MM 4000 front panel.

Associated errors:

- *Parameter exceeds limit (error C).*
- *Command authorized only in programming mode (error J).*
- *Unauthorized command in reduced link mode (error Q) (except during execution of a program).*

Example : *1DS Example ☞ Displays on line 1 of front panel the character chain "Example".*

Response : *None.*

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DV

Function : *Reads the automatic mode speed.*

Syntax : *xxDV where xx is the axis number.*

This reads the automatic mode speed previously assigned by VA.

Associated errors:

- *Incorrect axis number (error B).*

Example : *3DV ☞ Reads the automatic speed on axis 3.*

Response : *xxDVval where xx is the axis number and val the speed.*

DY

Function : *Displays a Y variable.*

Syntax : *xxDYval where xx is the display line number (1 or 2) and val the variable number.*

This displays aY variable on the MM 4000 front panel.

Associated errors:

- *Parameter exceeds limits (error C).*
- *Command authorized only in programming mode (error J).*
- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q) (except during execution of a program).*

Example : *1DY15 ☞ Displays the value of variable number 15 on line 1 of the MM 4000 front panel.*

Response : *None.*

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EP

Function : *Activates programming mode.*

Syntax : *xxEP where xx is the program number.*

This enters programming mode and remains in this mode until a QP command is sent to exit it. Each line received is loaded into RAM. If the program already exists, these lines will be added at the end. To rewrite program xx, you must first erase it in RAM using command XX. The new program can then be loaded into backup memory using command SM.

Associated errors:

- *Program number or number of programs is incorrect (error F).*
- *Unauthorized command in programming mode (error I).*
- *Program is too long (error M).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2EP ☞ Starts the writing of program number 2.*

Response : *None.*

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EX

Function : *Executes a program.*

Syntax : *xxEXval where xx is the program number and val the number of times the program will be executed.*

This executes a program, which is automatically compiled first. If an error is detected during compilation, execution is canceled. It is a good idea to check for errors beforehand by compiling the program with command CP to verify its syntax. The controller processes successively each program command. The user regains control only after the program has finished execution or when the user sends one of the following commands: AP, AB, MF, RS, or ST. All other controller activity during program execution is suspended, except demands for reading information, for example, TS, TP, etc.

Associated errors:

- *Parameter exceeds limits (error C).*
- *Program number or number of programs is incorrect (error F).*
- *Program does not exist (error G).*
- *Unauthorized command in programming mode (error I).*
- *Refers to a undefined label (error K).*
- *Command must be at the beginning of the line (error L).*
- *Label number is incorrect (error N).*
- *Variable exceeds limits (error O).*
- *Command cannot occur at beginning of line (error R).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2EX1 ☞ Executes program number 2 once.*

Response : *None.*

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FE

Function : *Defines the maximum tracking error.*

Syntax : *xxFEval where xx is the axis number and val the error value.*

This defines the maximum tracking error value. This value is the maximum allowed distance between actual positions and their instantaneous theoretical positions. If this difference is exceeded, the controller stops all displacements in progress. The controller, however, will only use a new maximum tracking error after receiving a UF command.

Associated errors:

- *Incorrect axis number (error B).*
- *Parameter exceeds limits (error C).*

Example : *2FE0.1 ☞ Defines a maximum tracking error of 0.1 units for axis number 2.*

Response : *None.*

FT

Function : *Defines an output frequency.*

Syntax : *FTval where val is the value of the desired frequency in Hz.*

This generates a logic signal at val frequency. The signal is available on pin 24 of the 25-pin back panel connector with the following accuracies:

Freq. Range (Hz)	Delta F (Hz)	(Delta F)/F
0.1 - 20.00	0.001	1.0 E-5
20.00 - 250.00	0.010	4.5 E-5
250.00 - 500.00	0.020	9.0 E-5
500.00 - 1000.00	0.100	18.0 E-5
1000.00 - 2500.00	0.500	44.0 E-5
2500.00 - 5000.00	1.000	88.0 E-5

Associated errors:

- *Unauthorized command in reduced link mode (error Q).*

Example : *FT10 ☞ Generates a frequency of 10 Hz.*

Response : *None.*

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IE

Function : *Tests the equality of a logic input and a value.*

Syntax : *xxIEval where xx is the logic input number and val the test value.*

This tests if the logic input xx equals val. If so, the rest of the line will be executed; if not, execution passes to the next line. Therefore, the whole line must be considered a single instruction. An input can have only the value 0 or 1.

Associated errors:

- *Parameter exceeds limits (error C)*
- *I/O channel number is incorrect (error E).*
- *Command must be at the beginning of the line (error L).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2IE0,1PA10.25, 2PR5.651 ☞ If number 2 input is equal to 0, then do: an absolute displacement of 10.25 units on axis 1 and a relative displacement of 5.65 units on axis 2.*

Response : *None.*

JL

Function : *Jumps to a label.*

Syntax : *xxJL where xx is the label number.*

This moves execution around in the program other than line by line. You can thus go from one program line to another, having defined a label previously and jumping to it.

Associated errors:

- *Command authorized only in programming mode (error J).*
- *Label number incorrect (error N).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *3JL1 ☞ Execution jumps to label 3.*

Response : *None.*

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KD

Function : *Initializes the derivative Kd coefficient.*

Syntax : *xxKDval where xx is the axis number and val the Kd value.*

This defines a new value of the derivative Kd factor for the automatic control loop. The controller, however, will only use a new Kd coefficient when it receives a UF command.

Associated errors:

- *Incorrect axis number (error B).*
- *Parameter exceeds limits (error C).*

Example : *1KD0.02 ☞ Initializes the Kd coefficient for axis 1 to value 0.02.*

Response : *None.*

KI

Function : *Initializes the integrator Ki coefficient.*

Syntax : *xxKIval where xx is the axis number and val the Ki value.*

This defines a new value of the integrator Ki factor for the automatic control loop. The controller, however, will only use a new Ki coefficient when it receives a UF command.

Associated errors:

- *Incorrect axis number (error B).*
- *Parameter exceeds limits (error C).*

Example : *2KI0.03 ☞ Initializes the Ki coefficient for axis 2 to value 0.03.*

Response : *None.*

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KP

Function : *Initializes the proportional Kp coefficient.*

Syntax : *xxKPval where xx is the axis number and val the Kp value.*

This defines a new value of the proportional Kp factor for the automatic control loop. The controller, however, will only use a new Kp coefficient when it receives a UF command.

Associated errors:

- *Incorrect axis number (error B).*
- *Parameter exceeds limits (error C).*

Example : *1KP0.05 ☞ Initializes the Kp coefficient for axis 1 to value 0.05.*

Response : *None.*

LP

Function : *Rereads a program.*

Syntax : *xxLP where xx is the program number.*

This rereads a program found in RAM. A program in backup memory cannot be read until it is loaded into RAM using the MP command. Control is passed back to the user when the rereading is finished.

Associated errors:

- *Program number or number of programs is incorrect (error F).*
- *Program does not exist (error G).*
- *Unauthorized command in programming mode (error I).*

Example : *2LP ☞ Reads program number 2.*

Response : *None.*

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MC

Function : Activates manual mode.

Syntax : MC

This activates manual mode. In this mode you can use only the displacement arrow keys on the MM 4000 front panel for axes displacements.

Associated errors:

- Unauthorized execution (error D).
- Unauthorized command in reduced link mode (error Q).

Example : MC

Response : None.

MF

Function : Stops movements and power to the axes.

Syntax : MF

This forces an emergency stop, and therefore halts all displacements in progress with a short deceleration and then a power cut. This command should be used with caution.

Warning: This command acts simultaneously on all valid axes.

⚠ **!! USE WITH CAUTION.**

Example : MF

Response : None.

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ML

Function : *Activates local mode.*

Syntax : *ML*

This activates the local mode. This mode lets you access all functions of the MM 4000 from the front panel.

Associated errors:

- *Unauthorized execution (error D).*
- *Program number or number of programs is incorrect (error F).*
- *Program does not exist (error G).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *ML*

Response : *None.*

MO

Function : *Turns on power to the axes.*

Syntax : *MO*

This powers the motors.

Associated errors:

- *Unauthorized command in reduced link mode (error Q).*

Example : *MO*

Response : *None.*

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MP

Function : *Calls programs from backup memory.*

Syntax : *MP*

This copies programs from backup memory into RAM. For example, after an XX command, it lets you reload programs from the backup memory after a loss of data.

Associated errors:

- *Unauthorized command in programming mode (error I).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *MP*

Response : *None.*

MR

Function : *Activates remote control mode.*

Syntax : *MR*

This activates the remote control mode where the controller waits for instructions via the exterior link from a host calculator. The front panel keypad is blocked in this mode.

Associated errors:

- *Unauthorized execution (error D).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *MR*

Response : *None.*

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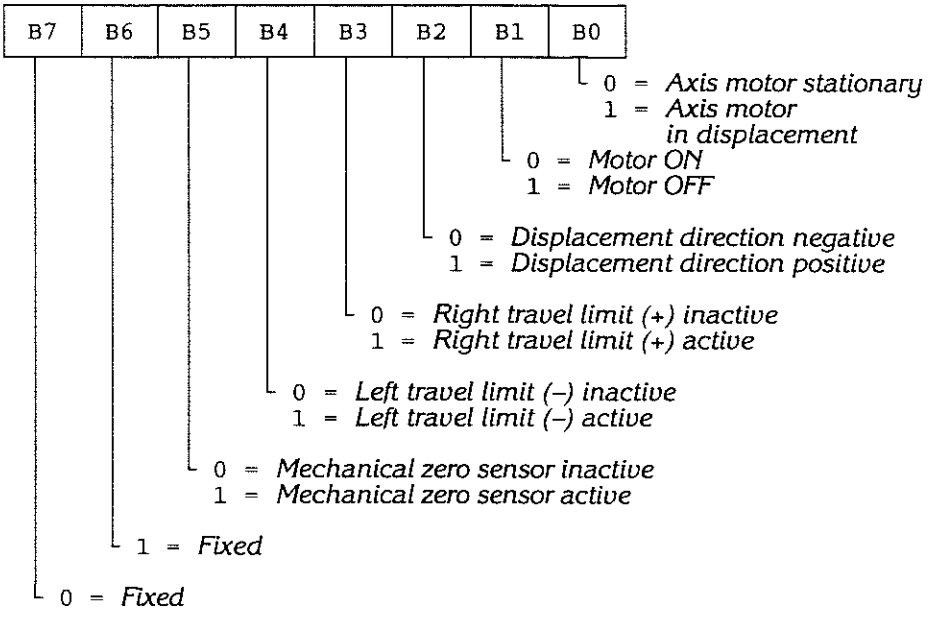
MS

Function : *Reads the status of an axis motor.*

Syntax : *MS or xxMS where xx is the axis number.*

This reads the status of an axis motor. The controller returns an octet representing the motor's status according to the chart below. Each octet bit returned represents a specific motor state. If xx does not exist or is null, the controller returns the status of all axes.

Refer to Appendix A for a detailed list of all the status codes.



Associated errors:

- *Axis number incorrect (error B).*

Example : *2MS ☞ Returns the status of motor number 2.*

Response : *xxMSval where xx is the axis number and val the hexadecimal status of this motor, or 1MSval,2MSval in response to MS for a two-axes system.*

Example of response: 2MSA ☞ Axis number 2 has no displacement limit and is moving in the negative direction with its motor powered.

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NP

Function : *Reads the number of programs.*

Syntax : *NP*

This returns the number of programs present. This number can be modified using the memory partitioning command PP.

Example : *NP ☞ Reads the the number of programs present.*

Response : *NPval where val equals the number of programs.*

OE

Function : *Tests for the equality of an output and a value.*

Syntax : *xxOEval where xx is the output number and val the test value.*

This tests if the output xx equals val. If so, the rest of the line is executed; if not, execution passes to the next line. Therefore, the complete line is considered a single instruction. A read-back of the output can only have the value 0 or 1.

Associated errors:

- *Parameter exceeds limits (error C).*
- *I/O channel number is incorrect (error E).*
- *Command must be at the beginning of the line (error L).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *3OE0, 1PA13.56, 2PR8.74 ☞ If output 3 equals zero, then do: an absolute displacement of 13.56 units on axis 1 and a relative displacement of 8.74 units on axis 2.*

Response : *None.*

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OH

Function : *Defines the origin search speed.*

Syntax : *xxOHval where xx is the axis number and val the speed value.*

This defines the value of the origin search speed (val). Each axis (xx) can have a different origin search speed.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1OH100 ☞ Defines a origin search speed of 100 units/s for axis number 1.*

Response : *None.*

OR

Function : *Searches for origin.*

Syntax : *xxOR or OR where xx is the axis number.*

This executes a mechanical origin search on an axis, or on all axes if xx is omitted or equal to zero. The order of the search on all axes is defined in the controller configuration. This command has no parameters.

Associated errors:

- *Axis number incorrect (error B).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2OR ☞ Performs an origin search on axis 2.*

Response : *None.*

PA

Function : *Executes an absolute displacement.*

Syntax : *xxPAval where xx is the axis number and val the position value in units.*

This displaces axis xx to absolute position val.

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The position value can be changed on the fly provided the resulting movement is in the same direction. Otherwise the speed sign would change during the displacement which would lead to infinite deceleration/acceleration. This is not acceptable for the mechanical stage. If you need to do that, first stop the current motion using the ST command and run the new motion you desire.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*
- *Unauthorized execution (error D) (motors not powered).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1PA5.84 ☞ Performs an absolute displacement of 5.84 units on axis number 1.*

Response : *None.*

PP

Function : *Partitions program memory.*

Syntax : *xxPP where xx is the number of programs.*

This divides RAM into xx number of memory blocks (xx cannot exceed 64), according to the user's need. Each block corresponds to a program. Thus, xx is the program number, and also the block memory number occupied by the program. This block must be cleared beforehand using the XX command. The total memory size available for the programs is 30 koctets. The size of a program is therefore 30/xx koctets. Backup memory is also completely cleared and repartitioned which means all the data there is lost.

Associated errors:

- *Number of programs or program number incorrect (error F).*
- *Partitioning canceled, program(s) present (error H).*
- *Unauthorized function in programming mode (error I).*
- *Unauthorized command in reduced link mode (error Q).*

⚠ ***!!USE THIS COMMAND WITH CAUTION.***

Example : *4PP ☞ Partitions RAM into four program blocks.*

Response : *None.*

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PR

Function : *Executes a relative displacement.*

Syntax : *xxPRval where xx is the axis number and val the displacement value.*

This moves axis xx by value val.

The position value can be changed on the fly provided the resulting movement is in the same direction. Otherwise the speed sign would change during the displacement which would lead to infinite deceleration/acceleration. This is not acceptable for the mechanical stage. If you need to do that, first stop the current motion using the ST command and run the new motion you desire.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*
- *Unauthorized execution (error D) (motors not powered).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1PR15.60 ☞ Performs a relative displacement of 15.60 units on axis number 1.*

Response : *None.*

PW

Function : *Saves the axis parameters in backup memory.*

Syntax : *xxPW where xx is the axis number.*

If the axis number is zero or does not exist, the command will save all the parameters on all the axes in backup memory. When xx is a valid axis number, then only its parameters are saved.

Associated errors:

- *Axis number incorrect (error B).*
- *Unauthorized execution (error D) (motors powered).*
- *Failure occurred while accessing the EEPROM (error U).*

Example : *1PW ☞ Saves the parameters of axis number 1 in backup memory.*

Response : *None.*

Comment: *After switching on power to the controller, it is recommended that you you execute a TE or TB command to verify that the axes parameters have been properly read from the EEPROM.*

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QP

Function : *Exits programming mode.*

Syntax : *xxQP where xx is the program number.*

This terminates programming mode. Afterward you are left in link mode where each line sent to the controller is immediately processed. (If the program exceeds its allowed size (refer to command PP), the controller exits programming mode, as if it had received a QP command; the program is left truncated in memory and the error M is generated.)

Associated errors:

- *Number of programs or program number incorrect (error F).*
- *Unauthorized command in programming mode (error I).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2QP☞ Terminates writing for program number 2.*

Response : *None.*

RA

Function : *Reads an analog input.*

Syntax : *xxRA where xx is the analog input number.*

This reads one of the two analog inputs. If xx is null or non-existent, all the analog inputs are read.

Associated errors:

- *I/O channel number is incorrect (error E).*

Example : *1RA*

Response : *xxRAval where xx is the analog input number and val the input value, which can range from 0 to 255. If xx is null or non-existent, the response will have the following form: 1RAval1, 2RAval2, where val1 and val2 are between 0 and 255.*

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RB

Function : *Reads a logic input.*

Syntax : *xxRB where xx is the TTL logic input number.*

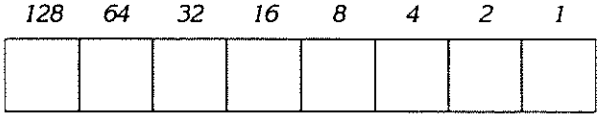
This reads each TTL input. The input number to be read is between 1 and 8. If xx does not exist or has a null value, all the inputs will be read.

Associated errors:

- *I/O channel number is incorrect (error E).*

Example : *1RB*

Response : *xxRBval where xx is the logic input number and val the value of the status (0 or 1). If xx does not exist or is null, this command returns a value between 0 and 255 and a code whose description is given below:*



The value equals: val = (Status Bit 8 x 128) + (Status Bit 7 x 64) + (Status Bit 6 x 32) + (Status Bit 5 x 16) + (Status Bit 4 x 8) + (Status Bit 3 x 4) + (Status Bit 2 x 2) + StatusBit1, where Status Bit i = 0 or 1.

RP

Function : *Repeats a command line.*

Syntax : *RPval where val is the number of repetitions.*

This repeats val number of times everything preceding it on the command line.

Associated errors:

- *Command cannot be at beginning of line (error R).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1PR15.2, 2PR2.5, WS,RP10 ☞ Repeat 10 times the following sequence: an relative displacement of 15.2 units on axis 1, an relative displacement of 2.5 units on axis 2, and wait after the end of displacements.*

Response : *None.*

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RS

Function : *Reinitializes the controller.*

Syntax : *RS*

This reinitializes the controller by resetting the central processing unit.

⚠ ***!!USE THIS COMMAND WITH CAUTION.***

Example : *RS*

Response : *None.*

SB

Function : *Sets a logic output to 1.*

Syntax : *xxSB where xx is the logic output number.*

This sets the TTL output xx to 1. If xx is null or non-existent, all the logic outputs are set to 1.

Associated errors:

- *I/O channel number is incorrect (error E).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2SB ☞ Sets logic output number 2 to value 1.*

Response : *None.*

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SC

Function : *Defines the type of control loop (open or closed).*

Syntax : *xxSCval where xx is the axis number and val is the type of loop (0 = open, 1 = closed).*

Defines the control loop for axis xx. If xx is null or non-existent, the command remains inactive; only one axis can be defined at a time. If val is non-existent, the axis is controlled in open loop by default.

Associated errors:

- *Axis number is incorrect (error B)*
- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2SC1 ☞ Axis 2 is managed in closed loop.*

Response : *None.*

SD

Function : *Defines the displacement speed as a percentage of the automatic speed.*

Syntax : *SDval where val is a percentage from 1 to 100 of the automatic speed.*

Associated errors:

- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *SD40 ☞ Defines the displacement speed as 40 percent of the automatic speed.*

Response : *None.*

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SE

Function : *Executes a synchronized displacement on an axis or axes.*

Syntax : *SE*

This starts the simultaneous displacement of all synchronized axes (defined by command SY).

Associated errors:

- *Unauthorized execution (error D).*
- *Unauthorized command in reduced link mode (error Q).*

Example :
1SY1 ☞ *Declares axis 1 as a synchronized axis.*
2SY1 ☞ *Declares axis 2 as a synchronized axis.*
1PA100 ☞ *Absolute position to be reached by axis 1.*
2PA30 ☞ *Absolute position to be reached by axis 2.*
SE ☞ *Starts the displacements together.*

Response : *None.*

SH

Function : *Defines the origin position.*

Syntax : *xxSHval where xx is the axis number and val the position value.*

This defines the axis position for mechanical origin.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2SH31.52* ☞ *Defines the origin at position 31.52 units for axis 2.*

Response : *None.*

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SL

Function : *Defines the left software travel limit (–).*

Syntax : *xxSLval where xx is the axis number and val the position limit value.*

This defines the software travel limit to the left, i.e., in the negative direction, at the position indicated. It lets you, for example, reduce the permitted travel because of an obstacle. The position limit must be greater than the value of the negative mechanical end-of-travel position and less than the positive travel limit value. No displacements will be allowed beyond this.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1SL-51.2 ☞ Defines the (–) travel limits of axis 1 at position -51.2 units.*

Response : *None.*

SM

Function : *Saves contents of RAM in backup memory.*

Syntax : *SM or xxSM where xx is the program number.*

This saves one or all programs in backup memory so that you can recall the program when turning the controller on again.

Associated errors:

- *Number of programs or program number incorrect (error F).*
- *Unauthorized command in programming mode (error I).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2SM ☞ Saves program number 2 in backup memory.*

Response : *None.*

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SP

Function : *Defines the acquisition period in milliseconds.*

Syntax : *SPval where val is the acquisition period value from 0 to 10 ms.*

Defines the acquisition period in trace mode activated by the TM command. The period applies to all the axes, the default value is around 2 ms.

The acquisition period is a multiple of the acquisition period of the controller. This is not an exact number. The XS command should be used to know the period really accepted by the controller.

Associated errors:

- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *SP3 ☞ Sampling period is set at 3 ms.*

Response : *None.*

SR

Function : *Defines the right (+) software travel limit.*

Syntax : *xxSLval where xx is the axis number and val is the position limit value.*

Defines the software travel limit to the right, i.e., in the positive direction at the indicated position. Useful when you want to reduce the permitted travel limit due to an obstacle. This limit must be less than the positive end-of-travel position value and greater than the negative travel limit. No displacements will be allowed beyond this limit.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2SR25.1 ☞ Defines the (+) travel limit on axis 2 at position 25.1.*

Response : *None.*

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ST

Function : *Stops a displacement in progress.*

Syntax : *ST or xxST where xx is the axis number.*

This stops displacements on one or all axes with the programmed deceleration.

Associated errors:

- *Axis number incorrect (error B).*

Example : *ST*

Response : *None.*

SY

Function : *Declares an axis synchronized.*

Syntax : *xxSYval where xx is the axis number and val determines the synchronization or non-synchronization of the axis indicated.*

When the val value is null, the axis is declared autonomous and non-synchronized; when it is not null, the axis is declared synchronized.

Associated errors:

- *Axis number incorrect (error B).*
- *Unauthorized command in reduced link mode (error Q).*

Example :

1SY1 ☞ *Declares axis 1 synchronized.*
2SY1 ☞ *Declares axis 2 synchronized.*
1PA100 ☞ *Absolute position to be attained by axis 1.*
2PA30 ☞ *Absolute position to be attained by axis 2.*
SE ☞ *Starts the displacements.*
1SY0 ☞ *Declares axis 1 non-synchronized.*
2SY0 ☞ *Declares axis 2 non-synchronized.*

Response : *None.*

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TA

Function : *Reads the axis name.*

Syntax : *xxTA where xx is the axis number.*

Reads the axis name associated with the logic number xx, defined from the front panel by the INIT menu which is part of the axis configuration.

Associated errors:

- *Axis number is incorrect (error B)*

Example : *2TA ☞ Reads the name of axis 2.*

Response : *xxTAval, where xx is the axis number and val the character string containing the name of this axis.*

Example: 2TA MTM160-PP.

TB

Function : *Reads an error explanation.*

Syntax : *TB*

This is more complete than TE. The TE command only returns an error code xx, whereas TB returns an error code followed by a character string giving an explanation.

Note: Using the TE and TB commands resets the error code to @.

Example : *TB*

Response : *TBxx val where xx is the error code and val the explanation of the error.*

Example: "TBC Parameter exceeds limits." Following the use of TE or TB, the error register is reset to @.

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TC

Function : *Reads the type of control loop.*

Syntax : *xxTC where xx is the axis number.*

Reads the type of control loop for axis xx, i.e., open loop (0), or closed loop (1). The type of control loop is defined by the command SC.

Associated errors:

- *Axis number is incorrect (error B)*

Example : *3TC ☞ Reads the type of control loop for axis 3.*

Response : *xxTCval, where xx is the axis number and val the type of control loop (0 = open, 1 = closed).*

Example: 3TC1.

TE

Function : *Reads the error number.*

Syntax : *TE*

Each executed command updates the error code register. The error code value can be read using the TE command, except in CP compilation where it returns the error code automatically. An executed command normally sets this code value to @. The code and error explanation can be obtained using the TB command.

Note: Using the TE and TB commands sets the error code to @. It is therefore impossible to use the TB command just after the TE command to get an explanation. In this case refer to the list of errors given at the end of this section.

During program execution, TE returns error codes generated by the executed program but not those generated by commands sent via the link. However, for reduced link mode all the errors are returned whether or not they were generated by a priority task.

Response : *TEval where val is the error code.*

Example: "TEC". After the use of TE or TB, the error is reset to @.

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TG

Function : *Inverts a logic output.*

Syntax : *xxTG where xx is the logic output number.*

This sets the logic output xx at zero when it is at one, and at 1 when it is at zero. When xx is null or non-existent, all the logic outputs are inverted.

Associated errors:

- *I/O channel number is incorrect (error E).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2TG ☞ Inverts logic output number 2.*

Response : *None.*

TH

Function : *Reads a theoretical position.*

Syntax : *TH or xxTH where xx is the axis number.*

This reads the theoretical axis position at the instant the controller receives the command. If xx is non-existent or a null value, the controller returns the theoretical position of all axes.

Associated errors:

- *Axis number incorrect (error B).*

Example : *2TH ☞ Reads the theoretical position of axis 2.*

Response : *xxTHval where xx is the axis number and val the position value, or 1THval, 2THval in response to TH for a two-axes system.*

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TL

Function : *Reads the left travel limit (–).*

Syntax : *xxTL where xx is the axis number.*

This reads the value of the left travel limit (–), previously defined by the SL command or initialized in the controller.

Associated errors:

- *Axis number incorrect (error B).*

Example : *2TL ☞ Reads the left travel limit (–) of axis 2.*

Response : *xxTLval where xx is the axis number and val the value of the left travel limit (–).*

TM

Function : *Activates trace mode.*

Syntax : *xxTMval where xx is the axis number and val the number of measurements.*

This activates the trace mode, which lets you acquire with a 2 ms period the axis position during a displacement. When the mode is activated, position readings are performed automatically for each displacement command (PA, PR) in which val can be between 0 and 2000. The TT command rereads these measurements, and the SP command modifies the acquisition period.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example :

1TM1000	*☞ Activates the trace mode.*
1PA50.3	*☞ Starts a displacement on axis 1 of 50.3 units.*
50TT	*☞ Reads measurement number 50.*

Response : *None.*

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TN

Function : *Reads the measurement units for an axis.*

Syntax : *TN*

Reads the units (mm, µm, rad, etc.) applied to axis displacements defined by the menu on the controller front panel.

Response : *TNval, where val is the character string containing the units of measurement.*

Example: TNmm.

TP

Function : *Reads the encoder position (real).*

Syntax : *TP or xxTP where xx is the axis number.*

This gives the real running axis position at the instant the controller receives this command. If xx is non-existent or null, the controller returns the encoder position of all axes.

Associated errors:

- *Axis number incorrect (error B).*

Example : *3TP ☞ Reads the real position of axis 3.*

Response : *xxTPval where xx is the axis number and val the position value or 1TPval, 2TPval in response to TP for a two-axes system.*

TR

Function : *Reads the right travel limit (+).*

Syntax : *xxTR where xx is the axis number.*

This reads the right travel limit, defined previously by the SR command or initialized in the controller.

Associated errors:

- *Axis number incorrect (error B).*

Example : *3TR ☞ Reads the right travel limit (+) for axis 3.*

Response : *xxTRval where xx is the axis and val the right travel limit (+) value.*

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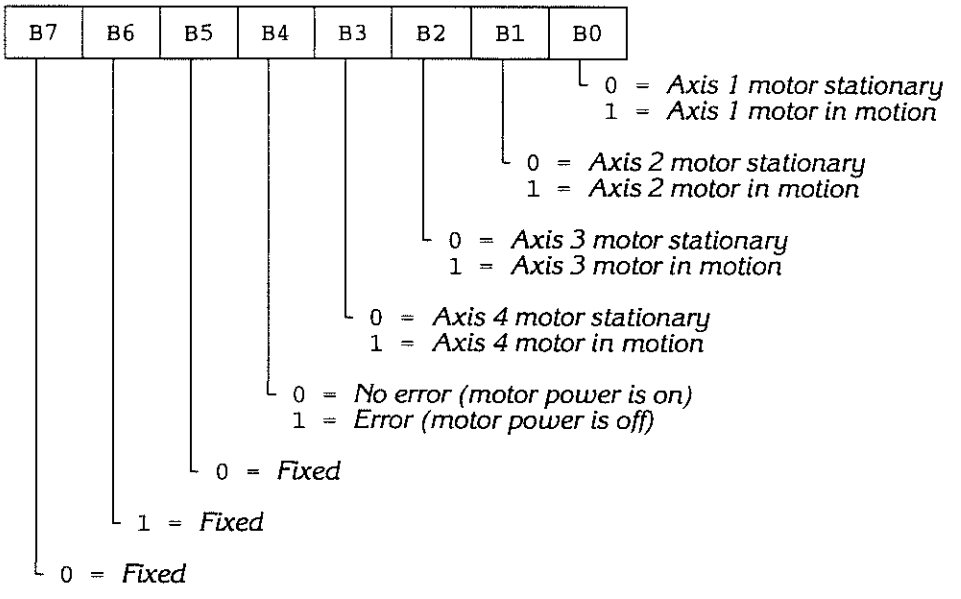
TS

Function : *Reads the status of the system.*

Syntax : *TS*

This reads the status of the system. The controller returns an octet representing the system status according to the diagram below. Each octet bit returned represents a specific state.

Refer to Appendix B for a more detailed list of these codes.



Example : *TS*

Response : *TSval where val is the hexadecimal representation of the status of the system.*

Example: "TSA" ☞ Axis one is moving, axes 2, 3, and 4 are stationary and motor power is on.

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TT

Function : *Reads the measurements recorded in trace mode.*

Syntax : *TT or xxTT where xx is the measurement number.*

After activating the trace mode (refer to TM) and executing a displacement (by commands PA or PR) on the axis selected by TM, this command reads the recorded position measurements. If xx is null or non-existent, all the recorded measurements are read.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*

Example : *2TT ☞ Rereads measurements read by the trace mode.*

Response : *xxTT, THval1, TPval2 where val1 is the theoretical position and val2 the real axis position at the moment of reading; the difference between val1 and val2 represents the instantaneous tracking error.*

Example: "2TT, TH0.001, TP0.002"

TU

Function : *Reads the units for an axis (encoder phase increment value).*

Syntax : *xxTU where xx is the axis number.*

Returns the encoder phase increment value for the xx axis. It is equal to the value of the encoder phase increment previously defined.

Associated errors:

- *Axis number incorrect (error B).*

Example : *2TU ☞ Reads the unit of measurement on axis 2.*

Response : *xxTUval where xx is the axis number and val the unit of position measurement.*

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TY

Function : *Reads a Y variable.*

Syntax : *xxTY where xx is the Y variable number.*

This reads the value of the Y variable.

Associated errors:

- *Variable exceeds limits (error O).*

Example : *3TY ☞ Reads the value of variable 3.*

Response : *xxTYval where xx is the variable number and val its value.*

UF

Function : *Updates the automatic control parameters Ki, Kp, Kd, and FE.*

Syntax : *UF or xxUF where xx is the axis number.*

This validates new values for the coefficients Ki, Kp, and Kd and the maximum tracking error sent using the commands KI, KD, KP, and FE for one or all axes.

Associated errors:

- *Axis number incorrect (error B).*

Example : *2UF ☞ Validates the new values of Ki, Kd, Kp, and the maximum tracking error for axis number 2.*

Response : *None.*

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UH

Function : *Enforces a "WAIT UNTIL" for a logic input to reach its high level.*

Syntax : *xxUH where xx is the logic input number.*

This suspends program execution until the logic input xx is at its high level.

Associated errors:

- *I/O channel number is incorrect (error E).*
- *Command authorized only in programming mode (error J).*
- *Command must be at the beginning of the line (error L).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1UH, 1PA10.2, 2PR5.03 ☞ Wait until the logic input 1 reaches its high level, then do an absolute displacement of 10.2 units on axis 1 and a relative displacement of 5.03 units on axis 2.*

Response : *None.*

UL

Function : *Enforces a "WAIT UNTIL" for a logic input to reach its low level.*

Syntax : *xxUL where xx is the logic input number.*

This suspends program execution until the logic input xx is at its low level.

Associated errors:

- *I/O channel number is incorrect (error E).*
- *Command authorized only in programming mode (error J).*
- *Command must be at the beginning of the line (error L).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2UL, 1PA10.2, 2PR5.03 ☞ Wait until the logic input 2 reaches its low level, then do an absolute displacement of 10.2 units on axis 1 and a relative displacement of 5.03 units on axis 2.*

Response : *None.*

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VA

Function : *Defines the speed in automatic mode.*

Syntax : *xxVAval where xx is the axis number and val the speed value.*

A new velocity value may be sent while a move is in progress. The MM 4000 will automatically accelerate or decelerate to the new velocity.

Associated errors:

- *Axis number incorrect (error B).*
- *Parameter exceeds limits (error C).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1VA50 ☞ Defines the automatic speed to be 50 units/s on axis 1.*

Response : *None.*

VE

Function : *Reads the version of the controller.*

Syntax : *VE*

This returns a character string identifying the type of controller as well as its version.

Response : *VExxxx where xxxx is the character string.*

Example: "VE MM4000 Controller Version XX.YY" where XX is the version number and YY the release number.

WA

Function : *Executes a pause.*

Syntax : *WTval or WAval where val is the wait time in ms.*

This forces a pause of val ms in program execution.

Associated errors:

- *Unauthorized command in reduced link mode (error Q).*

Example : *WA50 ☞ Executes a 50 ms pause.*

Response : *None.*

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WE

Function : *Exits WHILE loops.*

Syntax : *WE*

This terminates all WHILE loops associated with commands WY, WL, WG, WH. The WE command is obligatory for each of these commands.

Associated errors:

- *Command authorized only in programming mode (error J).*
- *Command must be at the beginning of the line (error L).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1YF0*
1WY10, 1PR10.6, 1WA1, WE ☞ While the variable 1 is not equal to 10, axis 1 moves 10.6 units and adds one to the variable.

Response : *None.*

WG

Function : *Enforces a WHILE loop when variable Y is greater than a value.*

Syntax : *xxWGval where xx is the variable number and val the test value.*

This constructs a loop around a test: is the variable Y number xx greater than val? While the test is true, all the commands are executed up to the next WE, then execution returns to the xxWGval line and the inequality condition re-tested. When the test is false, the loop is exited and execution goes to the next line after the WE.

Associated errors:

- *Command authorized only in programming mode (error J).*
- *Command must be at the beginning of a line (error L).*
- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *3YF30*
3WG15, 2PR5.2, 3YA-1, 1DY3, WE ☞ While the variable 3 is greater than 15, axis 2 is displaced 5.2 units, one is subtracted from variable 3 and this variable is displayed on line 1 of the controller front panel.

Response : *None.*

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WH

Function : *Enforces a "WHILE the logic input equals (a value)".*

Syntax : *xxWHval where xx is the logic input number and val is the test value.*

This tests the TTL input number xx with the value of val. While the logic input xx equals val, the instructions between WH and the next WE are executed. As soon as the test is false, the loop is exited and execution passes to the line following WE. An input can only have the values 0 or 1. All non-null values of val are considered equal to 1.

Associated errors:

- *I/O channel number is incorrect (error E).*
- *Command authorized only in programming mode (error J).*
- *Command must occur at the beginning of the line (error L).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *5WH0, 2PR10.40, 2YA1, 1DY2, WE ☞ While TTL input number 5 equals zero, axis 2 is displaced 10.40 units, 1 is added to variable 2 and variable 2 is displayed on line one of the controller front panel.*

Response : *None.*

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WK

Function : *Enforces a "Wait for key input from front panel".*

Syntax : *WKval where val is the an ASCII message with a maximum of 14 characters.*

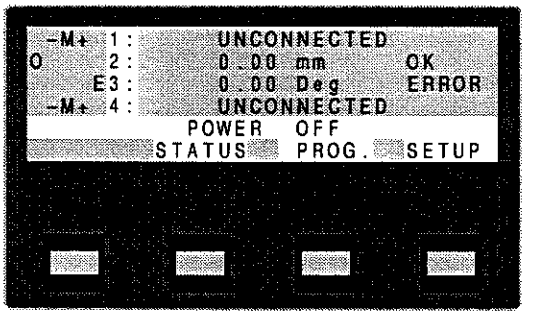
This enforces a wait until you press a key on the MM 4000 front panel. During this wait, the message val is displayed on the first line of the display.

On the second line a message appears which indicates which key the operator must press in order to continue or to stop execution of the program.

Associated errors:

- *Command authorized only in programming mode (error J).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *WKWait ☞ The front panel then appears as below:*



Example of screen display after a WK command.

Response : *None.*

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WL

Function : *Enforces a "WHILE" loop when variable Y is less than a value.*

Syntax : *xxWLval where xx is the variable number and val the test value.*

This constructs a loop around a test: is the variable Y number xx less than val? While the test is true, all the commands are executed up to the next WE, then execution returns to the xxWLval line and the inequality condition re-tested. When the test is false, the loop is exited and execution goes to the next line following WE.

Associated errors:

- *Command authorized only in programming mode (error J).*
- *Command must be at the beginning of a line (error L).*
- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2WL25, 2YA1,1PR11.2, WE ☞ While the variable 2 is less than 25, one is added to variable 2 and axis 1 is displaced 11.2 units.*

Response : *None.*

WP

Function : *Enforces a "WAIT for displacement to end".*

Syntax : *xxWPval where xx is the axis number and val the absolute position.*

This enforces a WAIT in program execution while a displacement reaches its val position on the mechanical axis. Useful in applications requiring multi-axes position synchronization.

Associated errors:

- *Axis number incorrect (error B).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1WP50 ☞ Waits until axis number 1 reaches the position 50 units.*

Response : *None.*

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WS

Function : *Enforces a "WAIT for displacement to end" plus a time delay.*

Syntax : *xxWSval where xx is the axis number and val the pause value after the axis stops.*

This enforces a WAIT until the expected displacement has finished followed by a specific time delay before executing the next command. If xx is not defined, the pause is valid for all the axes. If val is not defined, there is no pause after the displacement stops.

Associated errors:

- *Axis number incorrect (error B).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1WS50 ☞ Waits until axis number 1 has finished its displacement, then waits 50 ms.*

Response : *None.*

WT

Function : *Executes a pause.*

Syntax : *WTval or WAval where val is the wait time in ms.*

This forces a pause of val ms in program execution.

Associated errors:

- *Unauthorized command in reduced link mode (error Q).*

Example : *WT50 ☞ Executes a 50 ms pause.*

Response : *None.*

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WY

Function : *Enforces a "WHILE" loop when variable Y is different than a value.*

Syntax : *xxWYval where xx is the variable number and val the test value.*

This constructs a WHILE loop but only in programming mode. While variable Y number xx is different than val, the program executes all the commands up to the next WE command, then returns to xxWYval. As soon as the test is false, the loop is exited and the line following WE is executed.

Associated errors:

- *Command authorized only in programming mode (error J).*
- *Command must be at the beginning of a line (error L).*
- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1YF200*
1WY50, 1YA-2, 1PR10
WE
☞ *While the variable 1 is different than 50, the value 2 is subtracted from the value of variable 1 and there is a displacement of 10 units on axis 1.*

Response : *None.*

XD

Function : *Reads the derived factor Kd.*

Syntax : *xxXD where xx is the axis number.*

This reads the value of the automatic control derived factor for an axis, assigned by the commands KD and UF, or stored with the axis parameters.

Associated errors:

- *Axis number incorrect (error B).*

Example : *1XD ☞ Reads factor Kd of axis 1.*

Response : *xxXDval where xx is the axis number and val is Kd.*

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XF

Function : *Reads the maximum axis tracking error.*

Syntax : *xxXF where xx is the axis number.*

This reads the maximum axis tracking value or the default value.

Associated errors:

- *Axis number incorrect (error B).*

Example : *2XF ☞ Reads the maximum tracking error for axis 2.*

Response : *xxXFval where xx is the axis number and val the maximum error value.*

XH

Function : *Reads the axis origin position.*

Syntax : *xxXH where xx is the axis number.*

This reads the value assigned by SH, or the default value initialized in the controller.

Associated errors:

- *Axis number incorrect (error B).*

Example : *3XH ☞ Reads the origin position of axis 3.*

Response : *xxXHval where xx is the axis number and val the value of the origin position.*

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XI

Function : *Reads the integral factor Ki.*

Syntax : *xxXI where xx is the axis number.*

This reads the value of the automatic control integral factor for an axis, assigned by the commands KI and UF, or stored with the axis parameters.

Associated errors:

- *Axis number incorrect (error B).*

Example : *4XI ☞ Reads factor Ki of axis 4.*

Response : *xxXIval where xx is the axis number and val is Ki.*

XN

Function : *Reads the current number of acquisitions.*

Syntax : *XN*

Returns the number of acquisitions completed, started with the TM command.

Response : *XN val, where val is the number of acquisitions performed.*

Example: XN 1000 ☞ At this point, the controller has performed 1000 acquisitions.

XP

Function : *Reads the proportional factor Kp.*

Syntax : *xxXP where xx is the axis number.*

This reads the value of the automatic control proportional factor for an axis, assigned by the commands KP and UF, or stored with the axis parameters.

Associated errors:

- *Axis number incorrect (error B).*

Example : *1XI ☞ Reads factor Kp of axis 1.*

Response : *xxXPval where xx is the axis number and val is Kp.*

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XS

Function : *Reads the acquisition period.*

Syntax : *XS*

Returns the acquisition period in trace mode, defined with the SP command.

Response : *XS val, where val is the value of the acquisition period.*

Example: XS 9 ☞ The acquisition period is 9 ms.

XX

Function : *Erases a program memory block.*

Syntax : *xxXX where xx is the program number.*

This erases the memory block assigned to program number xx in RAM. The program xx is cleared and ready to be rewritten.

Associated errors:

- *Number of programs or program number incorrect (error F).*
- *Unauthorized command in programming mode (error I).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2XX ☞ Erases program number 2 in RAM.*

Response : *None.*

YA

Function : *Adds a value to a Y variable.*

Syntax : *xxYAval where xx is the variable number of Y and val is the value to add.*

This adds the value val to the variable xxY.

Associated errors:

- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *1YA3 ☞ Adds 3 to the value of variable 1.*

Response : *None.*

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YE

Function : *Tests the equality of a Y variable to a value.*

Syntax : *xxYEval where xx is the Y variable number and val is the test value.*

This tests if variable xxY is equal to val. If so, the rest of the line is executed; if not, the rest of the line is ignored and execution passes to the next line. Therefore, the entire line is considered a single instruction.

Associated errors:

- *Command must be at the beginning of a line (error L).*
- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2YE5, 1PA5.6,2JL ☞ If variable 2 equals 5, then axis 1 is displaced 5.6 units and execution jumps to label 2.*

Response : *None.*

YG

Function : *Tests if a Y variable is greater than a value.*

Syntax : *xxYGval where xx is the variable number and val the test value.*

This tests if xxY is greater than val. If so, the rest of the line is executed; if not, the rest of line is ignored and execution passes to the next command line. Therefore, the entire line is considered a single instruction.

Associated errors:

- *Command must be at the beginning of a line (error L).*
- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2YG1, 2YA-1, 3JL ☞ If variable 2 is greater than 1, 1 is subtracted from variable 2 and execution jumps to label number 3.*

Response : *None.*

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YL

Function : *Tests if a Y variable is less than a value.*

Syntax : *xxYLval where xx is the variable number and val the test value.*

This tests if xxY is less than val. If so, the rest of the line is executed; if not, the rest of the line is ignored and execution passes to the next command line. Therefore, the entire line is considered a single instruction.

Associated errors:

- *Command must be at the beginning of a line (error L).*
- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *3YL15, 3YA1, 4JL ☞ If variable 3 is less than 15, then 1 is added to variable 3 and execution jumps to label 4.*

Response : *None.*

YS

Function : *Initializes a Y variable.*

Syntax : *xxYSval where xx is the Y variable number and val is the initialization value.*

This initializes variable xxY to val, i.e., xxY = val.

Associated errors:

- *Variable exceeds limits (error O).*
- *Unauthorized command in reduced link mode (error Q).*

Example : *2YS10 ☞ Initializes variable number 2 to value 10.*

Response : *None.*

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ERROR LISTING

@ : No error.

A : Unknown code message.

B : Axis number incorrect.

C : Parameter exceeds limits.

D : Unauthorized execution.

E : I/O channel number incorrect.

F : Number of programs or the program number incorrect.

G : Program non-existent.

H : Partitioning canceled, program(s) present.

I : Unauthorized command in programming mode.

J : Command authorized only in programming mode.

K : Reference to an undefined label.

L : Command must be at the beginning of the line.

M : Program too long.

N : Label number incorrect.

O : Variable exceeds limits.

P : Number of WHILEs and WENDs are different.

Q : Unauthorized command in reduced link mode.

R : Command must not be at the beginning of line.

U : Failure occurred while accessing the EEPROM.

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APPENDIX A: MOTOR STATUS

The table below explains the codes returned by the command MS and describes the status of the axis motor interrogated. The code, an octet, is read in its hexadecimal form. Each bit of this octet carries information.

First, several conventions must be explained:

- *For the axis motor (Bit 0), a check mark ✓ indicates the axis is moving.*
- *For the motor state (Bit 1), a check mark ✓ indicates the motor is not powered.*
- *For the displacement direction (Bit 2), a check mark ✓ indicates the displacement is positive.*
- *For the "+" displacement limit (Bit 3), a check mark ✓ indicates the limit is active.*
- *For the "–" displacement limit (Bit 4), a check mark ✓ indicates the limit is active.*
- *For the mechanical zero sensor (Bit 5), a check mark ✓ indicates it is active.*
- *Finally, Bit 6 is fixed at 1 and Bit 7 at 0.*

Note

When all parameters are inactive, the motor powered, and the direction negative, the returned code equals 64, i.e., "@" in the ASCII table.

	Bit							
	7	6	5	4	3	2	1	0
Code	Fixed at 0	Fixed at 1	Mechanical zero active	Left end-of-run active	Right end-of-run active	Positive displacement	Motor OFF	Axis motor active
@		✓						
A		✓						✓
B		✓					✓	
D		✓				✓		
E		✓				✓		✓
F		✓				✓	✓	
H		✓			✓			
I		✓			✓			✓
J		✓			✓		✓	
L		✓			✓	✓		
M		✓			✓	✓		✓
N		✓			✓	✓	✓	
P		✓		✓				
Q		✓		✓				✓

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	Bit							
	7	6	5	4	3	2	1	0
Code	Fixed at 0	Fixed at 1	Mechanical zero active	Left end-of-run active	Right end-of-run active	Positive displacement	Motor OFF	Axis motor active
R		✓		✓			✓	
T		✓		✓		✓		
U		✓		✓		✓		✓
V		✓		✓		✓	✓	
X		✓		✓	✓			
Z		✓		✓	✓		✓	
\		✓		✓	✓	✓		
^		✓		✓	✓	✓	✓	
`		✓	✓					
a		✓	✓					✓
b		✓	✓				✓	
d		✓	✓			✓		
e		✓	✓			✓		✓
f		✓	✓			✓	✓	
h		✓	✓		✓			
i		✓	✓		✓			✓
j		✓	✓		✓		✓	
l		✓	✓		✓	✓		
m		✓	✓		✓	✓		✓
n		✓	✓		✓	✓	✓	
p		✓	✓	✓				
q		✓	✓	✓				✓
r		✓	✓	✓			✓	
t		✓	✓	✓		✓		
u		✓	✓	✓		✓		✓
v		✓	✓	✓		✓	✓	
x		✓	✓	✓	✓			
z		✓	✓	✓	✓		✓	
!		✓	✓	✓	✓	✓		
~		✓	✓	✓	✓	✓	✓	

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APPENDIX B: SYSTEM STATUS

The table below explains the codes returned by the TS command and describes the system status. This code, an octet, is read in its hexadecimal form. Each bit of this octet carries information.

To fully understand the table below, several conventions must be explained:

- *For the axis motor (Bit 0), a check mark ✓ indicates the axis is moving.*
- *For axis number 1 (Bit 0), axis 2 (Bit 1), axis 3 (Bit 2), axis 4 (Bit 3), a check mark ✓ indicates the axis is moving.*
- *For the error code (Bit 4), a check mark ✓ indicates an error has occurred.*
- *Finally, Bit 5 is fixed at 0, Bit 6 at 1 and Bit 7 at 0.*

Note

When all the axes are stationary and no errors have occurred, the code equals 64, i.e., "@" in the ASCII table.

	Bit							
	7	6	5	4	3	2	1	0
Code	Fixed at			Error	Axis 4	Axis 3	Axis 2	Axis 1
	0	1	0	active	active	active	active	active
@		✓						
A		✓						✓
B		✓					✓	
C		✓					✓	✓
D		✓				✓		
E		✓				✓		✓
F		✓				✓	✓	
G		✓				✓	✓	✓
H		✓			✓			
I		✓			✓			✓
J		✓			✓		✓	
K		✓			✓		✓	✓
L		✓			✓	✓		
M		✓			✓	✓		✓
N		✓			✓	✓	✓	
O		✓			✓	✓	✓	✓
P		✓		✓				
Q		✓		✓				✓
R		✓		✓			✓	
S				✓			✓	✓

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	Bit							
	7	6	5	4	3	2	1	0
Code	Fixed at			Error active	Axis 4 active	Axis 3 active	Axis 2 active	Axis 1 active
	0	1	0					
T				✓		✓		
U				✓		✓		✓
V				✓		✓	✓	
W				✓		✓	✓	✓
X				✓	✓			
Y				✓	✓			✓
Z				✓	✓		✓	
[				✓	✓		✓	✓
\				✓	✓	✓		
]				✓	✓	✓		✓
^				✓	✓	✓	✓	
_				✓	✓	✓	✓	✓

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APPENDIX C: EXAMPLE PROGRAMS

EXAMPLE 1

RASTER SCAN PROGRAM

```
| RASTER SCAN program example;
| This program executes the following procedure three times:;
| Over a surface of 2x2 mm:;
| Moves 20 µm along axis 2,;
| Moves 50 x 20 µm along axis 1 and waits for a stop.;
| Moves 20 µm along axis 2.;
| Moves 50 x -20 µm along axis 1 and waits for a stop.;

1XX;                    | Erases program 1;
1EP;                    | Enters programming mode for program 1;
MO, WT100;              | Powers up with a 0.1s delay;
1OR,2OR,WS;             | Origin search along axes 1 and 2;
WKRASTER;               | Displays RASTER and waits for response from keypad;
1YS1;                   | Initializes variable Y1 to 1;
1DL;                    | Defines label 1;
   1DSCYCLE;            | Displays CYCLE on line 1;
   2DY1;                | Displays variable Y1 on line 2;
   1PA99,2PA99,WS,TH;   | Goes to absolute position (99, 99) and sends position;
   2YS0;                | Initializes the variable Y2 to 0;
   2WL10;               | WHILE LOOP when variable Y2 is less than 10;
      1PR0.02,WS,RP50;  | Executes 50x: relative displacement 20 µm along axis 1;
                        | and waits for stop;
      2PR0.02,WS,TH;    | Relative displacement of 20 µm along axis 2,;
                        | waits for stop, and sends the position.;
      1PR-0.02,WS,RP50; | Executes 50x: relative displacement -20 µm along axis 1;
                        | and waits for stop;
      2PR0.02,WS,TH;    | Relative displacement of 20 µm along axis 2,;
                        | waits for stop, and sends the position.;
      2YA1;             | Adds 1 to variable Y2;
   WE;                  | End of WHILE LOOP;
   1YA1;                | Adds 1 to variable Y1;
1YL4,1JL;               | If variable Y1 is less than 4, jumps to label 1;
1QP;                    | Exits programming mode;
```

If you want to save this program in backup memory, type the command 1SM; to compile it, type 1CP.

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EXAMPLE 2

PROGRAM: TTL IO

```
| Program example: TTL IO;
| This program executes displacements as well as TTL input/outputs.;
2XX;                    | Erases program 2;
2EP;                    | Enters programming mode for program 2;
MO,WT100;               | Powers up with 0.1s delay;
1SY0,2SY0;              | Declares axes 1 & 2 NON SYNCHRONIZED;
1OR,2OR,WS;             | Origin on axes 1 & 2;
WKTTLIO;                | Displays TTLIO and waits for a keypad input;
1DSTTLIO;               | Displays TTLIO on line 1;
2DSRUN;                 | Displays RUN on line 2;
1CB;                    | Sets the TTL output 1 to 0;
TG;                     | Changes all the TTL outputs;
1PA50,2PA50,WS,TH;      | Moves to absolute position (50, 50) and sends position;
2DSWAIT 1L;             | Displays WAIT 1L on line 2;
1UL;                    | Waits while TTL input 1 is 0;
2DSRUN;                 | Displays RUN on line 2;
1CB;                    | Sets the TTL output 1 to 0;
TG;                     | Changes all the TTL outputs;
1PA150,2PA150,WS,TH;    | Moves to absolute position (150, 150) and sends position;
2DSWAIT 1L;             | Displays WAIT 1L on line 2;
1UL;                    | Waits while TTL input 1 is 0;
2DSRUN;                 | Displays RUN on line 2;
1CB;                    | Sets the TTL output 1 to 0;
TG;                     | Changes all the TTL outputs;
1PA50,2PA150,WS,TH;     | Moves to absolute position (50, 150) and sends position;
2DSWAIT 1L;             | Displays WAIT 1L on line 2;
1UL;                    | Waits while TTL input 1 is 0;
2DSRUN;                 | Displays RUN on line 2;
1CB;                    | Sets the TTL output 1 to 0;
TG;                     | Changes all the TTL outputs;
1PA50,2PA50,WS,TH;      | Moves to absolute position (50, 50) and sends position;
WT100;                  | Waits 0.1s;
MF;                     | Powers down;
2QP;                    | Exits programming mode;
2SM;                    | Saves program 2 in backup memory;
2CP;                    | Compiles program 2;
```

This program is automatically saved in backup memory by the 2SM command and compiled by 2CP on the last two lines above.

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EXAMPLE 3

PROGRAM OF A NON-SYNCHRONIZED DISPLACEMENT

```
| Example of a NON SYNCHRONIZED DISPLACEMENT;
3XX;                    | Erases program 3;
3EP;                    | Enters programming mode for program 3;
MO,WT100;               | Powers up with 0.1s delay;
1SY0,2SY0;              | Declares axes 1 & 2 non synchronized;
WS,TH;                  | Waits for the end of the displacement and sends position;
1DSCYCLE;               | Displays CYCLE on line 1;
1YS0;                   | Sets variable Y1 to 0;
1WL5;                   | START WHILE LOOP when Y1 is less than 5;
   1YA1;                | Increments variable Y1;
   2DY1;                | Displays variable Y1 on line 2;
   SB;                  | Sets all TTL outputs to 1;
   1PR10;               | Displaces axis 1 by 10 units in + direction;
   2PR-5;               | Displaces axis 2 by 5 units in - direction;
   WS,TH;               | Waits for end of displacement and sends position;
   CB;                  | Sets all TTL outputs to 0;
   1PR-10;              | Displaces axis 1 by 10 units in - direction;
   2PR5;                | Displaces axis 2 by 5 units in + direction;
   WS,TH;               | Waits for end of displacement and sends position;
WE;                     | END of loop;
MF;                     | Powers down;
QP;                     | Exits programming mode;
3SM;                    | Saves program 3 in backup memory;
3CP;                    | Compiles program 3;
```

This program is automatically saved in backup memory by the 3SM command and compiled by 3CP on the last two lines above.

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EXAMPLE 4

PROGRAM OF A SYNCHRONIZED DISPLACEMENT

```
| Example of a SYNCHRONIZED DISPLACEMENT;
4XX;                    | Erases program 4;
4EP;                    | Enters programming mode for program 4;
MO,WT100;               | Powers up with 0.1s delay;
1SY1,2SY1;              | Declares axes 1 & 2 synchronized;
WS,TH;                  | Waits for the end of the displacement and sends position;
1DSCYCLE;               | Displays CYCLE on line 1;
1YS0;                   | Sets variable Y1 to 0;
1WL5;                   | START WHILE LOOP when Y1 is less than 5;
   1YA1;                | Increments variable Y1;
   2DY1;                | Displays variable Y1 on line 2;
   SB;                  | Sets all TTL outputs to 1;
   1PR10;               | Displaces axis 1 by 10 units in + direction;
   2PR-5;               | Displaces axis 2 by 5 units in - direction;
   SE;                  | Executes the displacement of the synchronized axes;
   WS,TH;               | Waits for end of displacement and sends position;
   CB;                  | Sets all TTL outputs to 0;
   1PR-10;              | Displaces axis 1 by 10 units in - direction;
   2PR5;                | Displaces axis 2 by 5 units in + direction;
   SE;                  | Executes the displacement of the synchronized axes;
   WS,TH;               | Waits for end of displacement and sends position;
WE;                     | END of loop;
MF;                     | Powers down;
QP;                     | Exits programming mode;
4SM;                    | Saves program 4 in backup memory;
4CP;                    | Compiles program 4;
```

This program is automatically saved in backup memory by the 4SM command and compiled by 4CP on the last two lines above.

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APPENDIX D: MOTOR POWER BOARD

D.1 GENERAL

The MM 4000 Controller is capable of managing and driving up to four motorized axes which are connected to power boards inside the controller from its back panel. You can replace or add motor power boards to match desired motor specifications and axis parameters. The information given in this section covers the common and specific electrical characteristics of available boards from Newport Corp. and their compatibility with other components (all cables linking the power boards to the motor stages can be ordered from Newport Corp.). Procedures are provided at the end of this section to guide you in removing and replacing motor power boards.

The common specifications and features of these boards are presented below; these include adjustable board components, choice of encoder power supply, and the Sub-D 25 motor connector pinouts. Specific features and characteristics for a power board are given later under its reference number heading.

D.2 STEPPER AND DC MOTOR POWER BOARDS

In general, the power boards can be divided into two groups: those for stepper motors and those for DC motors. An example of a stepper motor power board is shown in Figure D1. An example of a DC motor power board is shown in Figure D2.

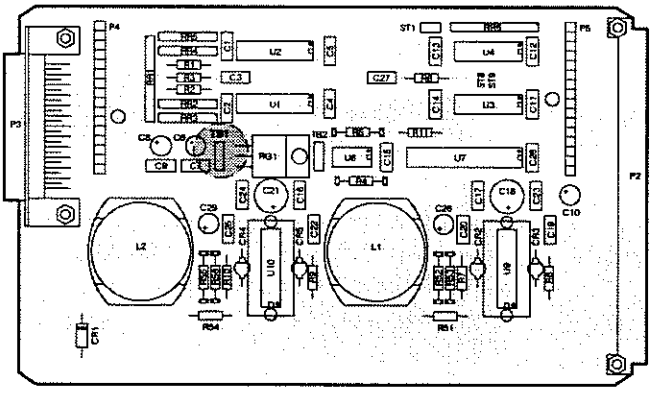


***Fig. D1**: Typical stepper motor power board showing a Sub-D 25 motor connector on the left edge, a DIN41-612 board connector on the right edge, and a selectable jumper (just below the Sub-D 25 connector [except for boards MM16PP-30-0.25 and MM16PP-30-0.5, circled], labeled TBx, etc.).*

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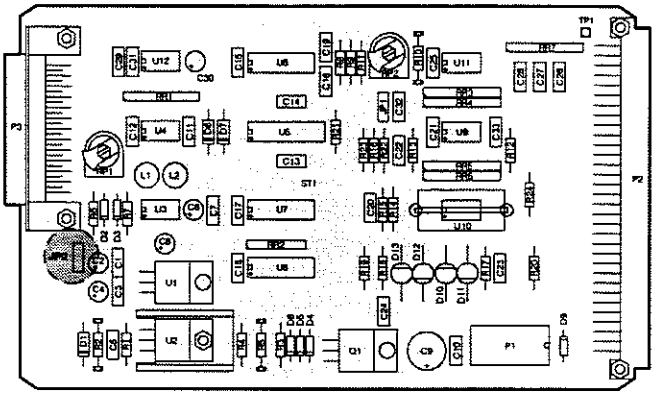


Fig. D2: *Typical DC motor power board showing a Sub-D 25 motor connector on the left edge, a DIN41-612 board connector on the right edge, a selectable jumper (circled just below the Sub-D 25 connector, labeled JPx, etc.) and two adjusting potentiometers (RPx, RGx, etc.).*

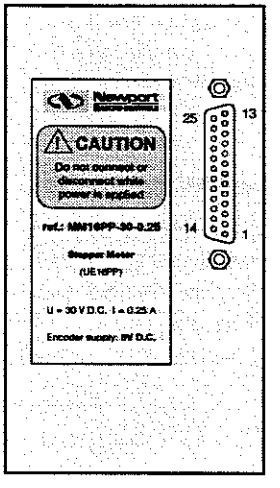


Fig. D3: *Power board panel showing labeling specifications and the Sub-D 25 connector.*

All these boards have a Sub-D 25 motor connector (top left board edge in Figures), a DIN41-612 board connector (right board edge), and a jumper which selects the power supply value for the encoders (circled just below the Sub-D 25 connector in Figures, [except for boards MM16PP-30-0.25 and MM16PP-30-0.5], labeled TBx, JPx, etc.). The Sub-D 25 connector and power board are attached to a small metal panel (Fig. D3) whose labeling indicates what type of motor (stepper or DC) the board powers, the board's model number, and its electrical output specifications.

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In addition to these common components, the DC power boards have two user adjustable potentiometers: one just behind the Sub-D 25 connector in Figure D2 and another at the top center board edge. The potentiometer behind the Sub-D 25 connector (labeled RP1, RG1, etc.) is an offset adjustment that can slightly vary the factory setting for the Zero Speed. The top edge potentiometer (labeled RP2, RG2, etc.) is a speed adjustment that can slightly vary the factory setting for the Motor Speed*.*

⚠ ***WARNING**: Contact Newport Corp. before attempting to adjust these potentiometers.*

D.3 SELECTABLE ENCODER POWER SUPPLY

*The jumper** located just below the Sub-D 25 motor connector in the board Figures (labeled TBx, JPx, etc.) provides two options for selecting the encoder power supply (refer to Fig. D4):*

1 +12 V when the top two terminals are connected,

2 +5 V when the bottom two terminals are connected.

⚠ ****WARNING**: Contact Newport Corp. before attempting to change this jumper position.*

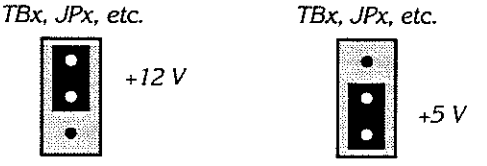


***Fig. D4**: Encoder power supply jumper (circled in board Figures D2 and D3, labeled TBx, JPx, etc.) which has two selectable positions for +12 V and +5 V supply.*

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D.4 SUB-D 25 MOTOR CONNECTOR PINOUTS

The motor connector pinouts can be specified in two sets: those for stepper motors and those for DC motors. The chart below gives the pinout for each:

Pin number	Stepper designation	DC designation
1	Phase 1	+ Tacho generator
2	Phase 1	– Tacho generator
3	Phase 2	+ Motor phase
4	Phase 2	+ Motor phase
5	Phase 3	– Motor phase
6	Phase 3	– Motor phase
7	Phase 4	
8	Phase 4	
9	Common phase 3-4	
10		
11	Common phase 1-2	
12		
13	Mechanical zero	Mechanical zero
14	Earth	Earth
15	Encoder index pulse I	Encoder index pulse I
16	0 V logic	0 V logic
17	+ End-of-travel	+ End-of-travel
18	– End-of-travel	– End-of-travel
19	Encoder channel A	Encoder channel A
20	Encoder channel B	Encoder channel B
21	Encoder power: +12 V, +5 V	Encoder power: +12 V, +5 V
22	0 V encoder	0 V encoder
23	Encoder channel /A	Encoder channel /A
24	Encoder channel /B	Encoder channel /B
25	Encoder NOT index pulse /I	Encoder NOT index pulse /I

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D.5 SPECIFIC POWER BOARD DATA

PMB16PP-30-0.25 POWER BOARD

Type: *Stepper motor supply.*

Supply: *I = 0.25 A; U = 30 V.*

Jumper label *for encoder supply: TB1 (located behind the Sub-D 25 connector, between it and the center of the board).*

Compatibility: *This board can drive the following stepper motor stages:*

- *MFN8-PP*
- *MFN25-PP*
- *VM4PP*
- *VM12.7PP*
- *VM25.4PP*

PMB16PP-30-0.5 POWER BOARD

Type: *Stepper motor supply.*

Supply: *I = 0.5 A; U = 30 V.*

Jumper label *for encoder supply: TB1 (located behind the Sub-D 25 connector, between it and the center of the board).*

Compatibility: *This board can drive the following stepper motor stages:*

- *UTS20-PP-0.1*
- *UTS20-PP-0.1-F*
- *UTS20-PP-1*
- *UTS20-PP-1-F*

PMB78PP-30-1 POWER BOARD

Type: *Stepper motor supply.*

Supply: *I = 1 A; U = 30 V.*

Jumper label *for encoder supply: TB3.*

Compatibility: *This board can drive the following stepper motor stages:*

- *UTM25-PP-0.1*
- *UTM25-PP-1-HL*
- *UTM50-PP-0.1*
- *UTM50-PP-1-HL*
- *UTM100-PP-0.1*
- *UTM100-PP-1-HL*
- *UTM150-PP-0.1*
- *UTM150-PP-1-HL*
- *UZS80-PP-0.1*
- *TIX200-PP-1*
- *TIX200-PP-0.5*
- *TIXY200-PP-1*
- *TIXY200-PP-0.5*
- *TIX200-PP-0.1*
- *TIXY200-PP-0.1*

PMB78PP-60-2 POWER BOARD

Type: *Stepper motor supply.*

Supply: *I = 2 A; U = 60 V.*

Jumper label *for encoder supply: TB3.*

⚠ ***WARNING:*** *Unlike the other power boards listed here, the upper two TB3 jumper terminals on this power board provide +5 V and the lower two +12 V for the encoder. Always consult Newport Corp. first before switching any jumper on a power board.*

Compatibility: *This board can drive the following stepper motor stages:*

- *UZM160-PP-0.1*
- *MTL100-PP-0.1*
- *MTL150-PP-0.1*
- *MTL200-PP-0.1*
- *MTL100-PP-1*
- *MTL150-PP-1*
- *MTL200-PP-1*
- *MTL250-PP-1*
- *MTL100-PP-2.54*
- *MTL150-PP-2.54*
- *MTL200-PP-2.54*
- *MTL250-PP-2.54*
- *MTL250-PP-0.1*
- *UBG120-PP*

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PMB16CC-12-0.1 POWER BOARD

Type: *DC motor supply.*

Supply: *I = 0.1 A; U = 12 V.*

Jumper label for encoder supply: *JP2.*

Offset potentiometer label: *RP1.*

Speed potentiometer label: *RP2.*

Compatibility: *This board can drive the following DC motor stages:*

- *MFN8-CC*
- *MFN25-CC*

PMB16CC-12-0.2 POWER BOARD

Type: *DC motor supply.*

Supply: *I = 0.2 A; U = 12 V.*

Jumper label for encoder supply: *JP2.*

Offset potentiometer label: *RP1.*

Speed potentiometer label: *RP2.*

Compatibility: *This board can drive the following DC motor stages:*

- *VM4-CC*
- *VM12.7-CC*
- *VM25.4-CC*

PMB16CC-24-0.15 POWER BOARD

Type: *DC motor supply.*

Supply: *I = 0.15 A; U = 24 V.*

Jumper label for encoder supply: *JP2.*

Offset potentiometer label: *RP1.*

Speed potentiometer label: *RP2.*

Compatibility: *This board can drive the following DC motor stages:*

- *UTS20-CC-0.1*
- *UTS20-CC-0.1-F*
- *UTS20-CC-1*
- *UTS20-CC-1-F*
- *UZS80-CC-0.1*
- *URM80-CC*
- *URM80-ACC*
- *URM100-CC*
- *URM100-ACC*
- *UBG50-CC*
- *UBG80-CC*

PMB16CC-24-0.3 POWER BOARD

Type: *DC motor supply.*

Supply: *I = 0.3 A; U = 24 V.*

Jumper label for encoder supply: *JP2.*

Offset potentiometer label: *RP1.*

Speed potentiometer label: *RP2.*

Compatibility: *This board can drive the following DC motor stages:*

- *UTM25-CC-0.1*
- *UTM50-CC-0.1*
- *UTM100-CC-0.1*
- *UTM150-CC-0.1*

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PMB78CC-60-0.9 POWER BOARD

Type: *DC motor supply.*

Supply: *I = 0.9 A; U = 60 V.*

Jumper label for encoder supply: *JP2.*

Offset potentiometer label: *RP1.*

Speed potentiometer label: *RP2.*

Compatibility: *This board can drive the following DC motor stages:*

- *UTM25-CC-1-HL*
- *UTM50-CC-1-HL*
- *UTM50-CC-0.5-HA*
- *UTM100-CC-1-HL*
- *UTM150-CC-1-HL*
- *UTM100-CC-0.5-HA*
- *UTM150-CC-0.5-HA*
- *TIX200-CC-0.1*
- *TIX200-CC-0.5*
- *TIXY200-CC-0.1*
- *TIXY200-CC-0.5*
- *TIX200-CC-1*
- *TIXY200-CC-1*

PMB78CC-60-1.2 POWER BOARD

Type: *DC motor supply.*

Supply: *I = 1.2 A; U = 60 V.*

Jumper label for encoder supply: *JP2.*

Offset potentiometer label: *RP1.*

Speed potentiometer label: *RP2.*

Compatibility: *This board can drive the following DC motor stages:*

- *UZM160-CC-0.1*
- *UBG120-CC*

PMB78CC-60-2 POWER BOARD

Type: *DC motor supply.*

Supply: *I = 2 A; U = 60 V.*

Jumper label for encoder supply: *JP2.*

Offset potentiometer label: *RP1.*

Speed potentiometer label: *RP2.*

Compatibility: *This board can drive the following DC motor stages:*

- *MTL100-CC-1*
- *MTL150-CC-1*
- *MTL200-CC-1*
- *MTL250-CC-1*
- *MTL100-CC-0.1-HA*
- *MTL150-CC-0.1-HA*
- *MTL200-CC-0.1-HA*
- *MTL250-CC-0.1-HA*

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D.6 ADDING OR REPLACING MOTOR POWER BOARDS

The MM 4000 rear panel features four removable connector panels each of which corresponds to a specific axis as shown in Figure D5. These panels attach to the motor power boards inside the MM 4000 controller. You can replace any of these boards when motor specifications are changed, or you can add boards when new motors are added to your axial system.

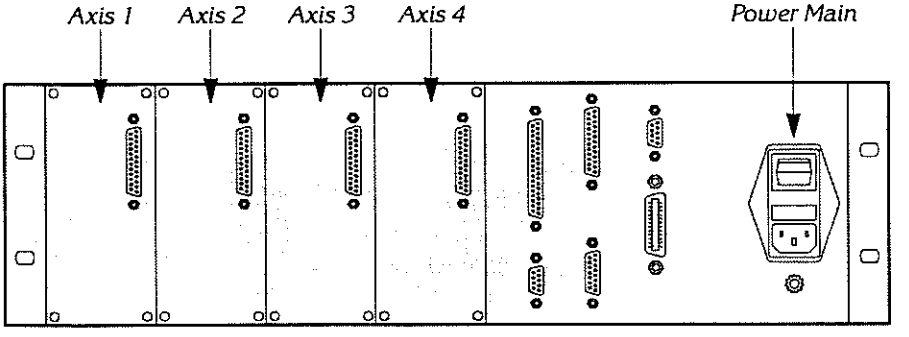


***Fig. D5**: The location of the four axis power board connectors on the MM 4000 back panel.*

BOARD REMOVAL

To remove a motor power board, do the following:

1. *Turn off power to the MM 4000 controller by pressing the ON/OFF button on the back panel and then disconnect the power cord.*
2. *Disconnect the cable between the axis motor and the power board you want to replace.*
3. *Remove the four screws from the board's connector panel.*
4. *Pull the connector panel and its power board straight back to remove it.*

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BOARD INSTALLATION

To replace or add a motor power board do the following:

1 *If you are adding a motor power board, first turn the power off to the MM 4000 controller by pressing the ON/OFF button on the rear panel and disconnect the power cord. Then remove the blank panel on the back of the MM 4000 controller (attached with four screws) where the new power board will be inserted.*

2 *Insert the board on the guides inside the controller that ensure correct positioning of the board.*

3 *Without forcing it, push the board all the way into the controller. If there is resistance, the board is probably not positioned correctly on the guides. Remove it and repeat step 2 above.*

4 *Attach the four screws that secure the connector panel to the controller back panel.*

5 *Connect the cable between the motor and the power board connector.*

6 *Reconnect the controller power cord and power up the controller by pressing the ON/OFF switch on the back panel.*

⚠ ***WARNING:*** *Before powering the motors from the MM 4000 front panel, first reconfigure the axis (steps 7, 8, 9 below) whose power board you have just changed or added.*

7 *Select the axis to be configured by pressing the following sequence of menu buttons on the MM 4000 front panel: SETUP, AXES, and AXIS #.*

8 *Initialize this axis by pressing the following sequence of menu buttons: CONFIG, AXES, SELECT.*

9 *If necessary, display and modify the parameters of this axis (measurement units, stepper motor, stepper encoder, speeds, etc.) by pressing the following sequence of menu buttons: CONFIG, AXES, MODIFY.*

For steps 7, 8, and 9 above refer to section "Configuring the Axes" for an explanation of the menu buttons.

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APPENDIX E: TROUBLESHOOTING

E.1 THE FRONT PANEL RED POWER INDICATOR DOES NOT LIGHT

- *Verify that the power cord is connected to a live outlet (to check if the outlet is working, connect another piece of equipment that you normally use and turn it on.) Press the power button on the rear of the controller. If the indicator light still does not come on, replace the fuses as explained below.*

⚠ ***CAUTION**: Before doing the fuse replacement procedure, switch the controller power button to its OFF position and disconnect the power cord from its power source.*

FUSE REPLACEMENT

Locate the small fuse cover on the back panel of the controller near the line power connection. Pry the cover open using a screwdriver to reveal the two power fuses. Remove both of these fuses and replace them with new fuses of the same specifications, i.e., T5A, 250 V.

E.2 CONTROLLER DECLARES AXIS DISCONNECTED.

- *Verify the connection between the stage and the controller.*
- *Turn the controller off and then on again to detect the axis (an axis can only be detected during its power up phase).*

⚠ ***CAUTION**: Turn the controller power OFF before connecting a motor stage.*

E.3 THE FRONT PANEL GREEN INDICATOR DOES NOT STAY ON

The green indicator light goes off when one of the mechanical axes registers an error, for example, when the maximum tracking error has been reached. The possible causes for this malfunction are the following:

- *The axis parameters in the general configuration do not correspond to the stage being used. Check the system configuration and change the parameters to correspond to the axis being used.*
- *The controller has detected an end-of-travel limit on an axis during automatic displacement. To escape from this physical limit, either do an origin search, if the axis has one, or move the axis in manual mode using the front panel keys.*
- *The load limits and usage conditions for a stage have been exceeded.*
- *The motor stage is not connected to the correct power board (refer to Appendix D.6).*

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E.4 THE AXIS DOES NOT MOVE.

Most often this is because the general configuration of the controller contains parameters that are incompatible with the stage. Check the system configuration and change its parameters to correspond to the stage being used.

E.5 STAGE DOES NOT ATTAIN EXPECTED PERFORMANCE LEVELS.

- *Verify that the stage is connected to the correct power board. Check that the information on the back panel of the board connector is identical to that of the stage in question.*
- *Verify that the parameters specified in the general configuration of the controller conform to those of the stage being used.*

E.6 THE AXIS MOTOR RUNS TOO HOT.

Verify that your stage is connected to the correct power board in the controller. Check that the information on the back panel of the board connector is identical to that on the stage in question.

E.7 THE AXIS REFUSES TO EXECUTE AN AUTOMATIC DISPLACEMENT.

- *The axis has reached one of its programmed limits and cannot continue to move in the same direction.*
- *The axis has reached a mechanical end-of-travel. Under this condition it is essential to escape from this physical limit to continue automatic displacement. To do this, either execute an origin search, if the axis has one, or move the axis in manual mode using the front panel keys.*

E.8 THE MM 4000 CONTROLLER AND THE EXTERNAL HOST COMPUTER DO NOT COMMUNICATE.

- *Verify in the controller's general configuration that you have selected the correct link having the same parameters as your controller, i.e.,:*
  - *IEEE-488: the main address, SRQ, and terminator;*
  - *RS-232: the transmission speed, number of parity bits, word length, number of stop bits and terminator.*

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APPENDIX F: AFTER SALES SERVICE

F.1 OBTAINING SERVICE

To receive after sales service, contact the Newport office nearest you or your local Newport representative. Please provide the following information when calling for service:

1. *The model number of your equipment or component, for example: MM 4000 or UTM150-PP-0.1;*
2. *If applicable the serial number of your equipment or component;*
3. *The description of the problem.*

If the equipment must be returned, you will be given a registration number from Newport Corporation. This number must appear on all documents sent to us. We ask you to fill out the After Sales Service form included in this section and to have all the information ready before contacting Newport Corporation. Return the completed form with the equipment.

F.2 PACKING INSTRUCTIONS

If the MM 4000 Controller must be returned to Newport Corporation for any reason, the packing instructions below should be followed to avoid damage during transport and to assure the quickest possible equipment return.

1. *If possible, return the equipment in its original packing material.*
2. *If the original packing material is damaged or unusable, try to duplicate all the packing and security precautions which were taken when the controller was shipped to you from the factory.*
3. *Remember to put the registration number on the box being sent back and to include the after sales service form to ensure the quickest return.*

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AFTER SALES SERVICE FORM

Name:	Registration Number:
Company:	(Obtained from Newport Corp. before return of equipment).
Adress:	
Country:	Date:
Zip Code:	Telephone:

Reason for return:

List of checkout procedures followed and description of the problem (add more pages if necessary).

Give the complete system block diagram, including all the instruments connected to the equipment (stages, power supplies, etc.):

What kind of environment is the equipment used in (research laboratory, quality control department, assembly, etc.):

What is the power source (utility outlet, converter, etc.):	
Frequency:	Variation:
Ambient temperature:	Variation:
Relative humidity:	Other:

Other information (for example, if modifications have been made to the equipment, please describe them):

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